# LeCroy
# Digital Oscilloscopes

## WaveRunner Xi Series Service Manual

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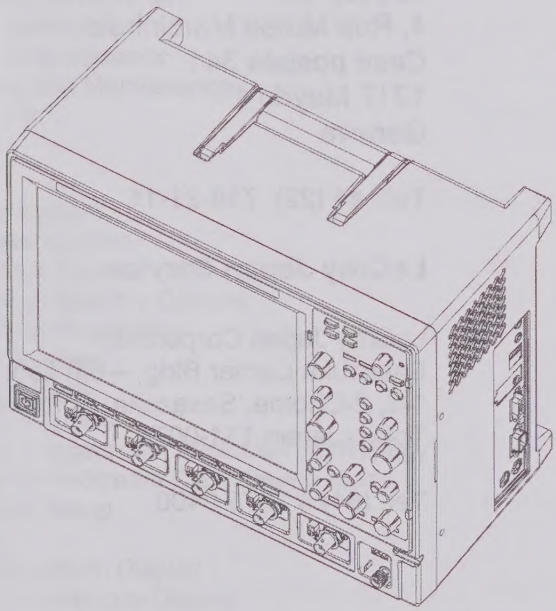
# LeCroy Color Digital Oscilloscopes

# WaveRunner Xi Series

# Service Manual



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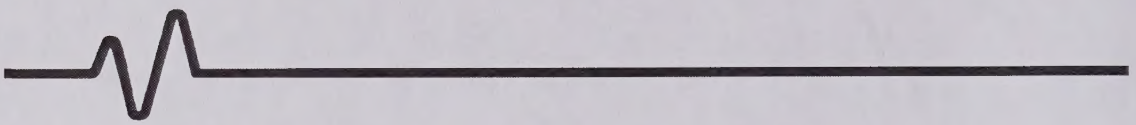


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**Read this first**


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## Replaceable Parts

**See section 7 for a listing of all boards and parts.**

## Mechanical Parts

**See section 8 for a listing of all boards and parts.**

# 1. Warranty and Product Support

It is recommended that you thoroughly inspect the contents of the oscilloscope packaging immediately upon receipt. Check all contents against the packing list/invoice copy shipped with the instrument. Unless LeCroy is notified promptly of any missing or damaged item, responsibility for its replacement cannot be accepted. Contact your nearest LeCroy Customer Service Center or national distributor immediately (see chapter 2 for *contact numbers*).

## 1.1 Warranty

LeCroy warrants its oscilloscope products for normal use and operation within specifications for a period of three years from the date of shipment. Calibration each year is recommended to ensure in-spec. performance. Spares, replacement parts and repairs are warranted for 90 days. The instrument's firmware has been thoroughly tested and is thought to be functional, but is supplied without warranty of any kind covering detailed performance. Products not made by LeCroy are covered solely by the warranty of the original equipment manufacturer.

Under the LeCroy warranty, LeCroy will repair or, at its option, replace any product returned within the warranty period to a LeCroy authorized service center. However, this will be done only if the product is determined after examination by LeCroy to be defective due to workmanship or materials, and not to have been caused by misuse, neglect or accident, or by abnormal conditions or operation.

## 1.2 Product Assistance

***Note:*** *This warranty replaces all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness, or adequacy for any particular purpose or use. LeCroy shall not be liable for any special, incidental, or consequential damages, whether in contract or otherwise. The client will be responsible for the transportation and insurance charges for the return of products to the service facility. LeCroy will return all products under warranty with transport prepaid.*

Help on installation, calibration, and the use of LeCroy equipment is available from the LeCroy Customer Service Center in your country.

## 1.3 Maintenance Agreements

LeCroy provides a variety of customer support services under Maintenance Agreements. Such agreements give extended warranty and allow clients to budget maintenance costs after the initial three-year warranty has expired. Other services such as installation, training, enhancements, on-site repairs and calibrations are available through special supplemental support agreements.

## 1.4 Staying Up to Date

LeCroy is dedicated to offering state-of-the-art instruments, by continually refining and improving the performance of LeCroy products. Because of the speed with which physical modifications may be implemented, this manual and related documentation may not agree in every detail with the products they describe. For example, there might be small discrepancies in the values of components affecting pulse shape, timing or offset, and — infrequently — minor logic changes. However, be assured the scope itself is in full order and incorporates the most up-to-date circuitry. LeCroy frequently updates firmware and software during servicing to improve scope performance, free of charge during warranty. You will be kept informed of such changes, through new or revised manuals and other publications.

**Nevertheless, you should retain this, the original manual, for future reference to your scope's hardware specifications.**

## 1.5 Service and Repair

Please return products requiring maintenance to the Customer Service Department in your country or to an authorized service facility. The customer is responsible for transportation charges to the factory, whereas all in-warranty products will be returned to you with transportation prepaid. Outside the warranty period, you will need to provide us with a purchase order number before we can repair your LeCroy product. You will be billed for parts and labor related to the repair work, and for shipping.

## 1.6 How to return a Product

Contact the nearest LeCroy Service Center or office to find out where to return the product. All returned products should be identified by model and serial number. You should describe the defect or failure, and provide your name and contact number. In the case of a product returned to the factory, a Return Authorization Number (RAN) should be used.

Return shipments should be made prepaid. We cannot accept COD (Cash On Delivery) or Collect Return shipments. We recommend air-freighting.

It is important that the RAN be clearly shown on the outside of the shipping package for prompt redirection to the appropriate LeCroy department.

***Note:** Wherever possible, please use the original shipping carton. If a substitute carton is used, it should be rigid and packed so that that the product is surrounded by a minimum of four inches or 10 cm of shock-absorbent material.*

# 2. General Information

## 2.1 Product Assistance

Help on installation, calibration, and the use of LeCroy equipment is available from your local LeCroy office, or from LeCroy's

- Customer Care Center, 700 Chestnut Ridge Road, Chestnut Ridge, New York 10977–6499, U.S.A., tel. (845) 578–6020
- European Service Center, 4, Rue Moïse Marcinhes, Case postale 341, 1217 Meyrin 1, Geneva Switzerland, tel. (41) 22/719 21 11.
- LeCroy Japan Corporation, Sasazuka Center Bldg – 6th floor, 1-6, 2-Chome, Sasazuka, Shibuya-ku, Tokyo Japan 151-0073, tel. (81) 3 3376 9400

## 2.2 Installation for Safe and Efficient Operation

### Operating Environment

The oscilloscope will operate to its specifications if the environment is maintained within the following parameters:

Temperature .....5 to 40 °C (41 to 104 °F) rated.

Humidity .....Maximum relative humidity 80 % RH (non-condensing) for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C

Altitude .....2000 m (6560 ft)

The oscilloscope has been qualified to the following EN61010-1 category:

Installation (Overvoltage) CategoryII

Pollution Degree .....2

### Safety Symbols

Where these symbols or indications appear on the front or rear panels, and in this manual, they have the following meanings:

..... **CAUTION**: Refer to accompanying documents (for Safety-related information). *See elsewhere in this manual wherever the symbol is present,as indicated in the Table of Contents.*

..... **CAUTION**: Risk of electric shock

..... **On (Supply)**

 **Off (Supply)**

..... Earth (Ground) Terminal

..... **Protective Conductor Terminal**

..... **Earth (Ground) Terminal on BNC Connectors**

**WARNING** ..... **Denotes a hazard. If a WARNING is indicated on the instrument, do not proceed until its conditions are understood and met.**

**Any use of this instrument in a manner not specified by the manufacturer may impair the instrument's safety protection.**

The oscilloscope has *not* been designed to make direct measurements on the human body. Users who connect a LeCroy oscilloscope directly to a person do so at their own risk.

## Power Requirements

The oscilloscope operates from a 115 V (90 to 132 V) or 220 V (180 to 250 V) AC power source at 45 Hz to 66 Hz. No voltage selection is required, since the instrument automatically adapts to the line voltage present.

Maintain the ground line to avoid an electric shock.

None of the current-carrying conductors may exceed 250 V rms with respect to ground potential. The oscilloscope is provided with a three-wire electrical cord containing a three-terminal polarized plug for mains voltage and safety ground connection.

The plug's ground terminal is connected directly to the frame of the unit. For adequate protection against electrical hazard, this plug must be inserted into a mating outlet containing a safety ground contact.

## Cleaning And Maintenance

Maintenance and repairs should be carried out exclusively by a LeCroy technician Cleaning should be limited to the exterior of the instrument only, using a damp, soft cloth. Do not use chemicals or abrasive elements. Under no circumstances should moisture be allowed to penetrate the oscilloscope. To avoid electric shocks, disconnect the instrument from the power supply before cleaning.

**Risk of electrical shock: No user serviceable parts inside. Leave repair to qualified personnel.**

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# 3. Specifications

## 3.1 Vertical System

| | WaveRunner 44Xi | WR 64Xi/62Xi | WR104Xi/204Xi |
|---|---|---|---|
| Nominal Analog Bandwidth @ 50Ω, 10 mV-1 V/div | 400 MHz | 600 MHz | 1GHz/2GHz |
| Rise Time (Typical) | 875 ps | 625 ps | 400 ps/225 ps |
| Input Channels | 4 | 4/2 | 4 |
| Bandwidth Limiters | 20 MHz; 200 MHz | | |
| Input Impedance | 1 MΩ \|\| 16 pF | | |
| Input Coupling | 50Ω: DC, 1 MΩ: AC, DC, GND | | |
| Maximum Input Voltage | 50Ω: 5 Vrms, 1 MW: 400 V max (DC + Peak AC: ≤ 5 kHz) | | |
| Vertical Resolution | 8 bits; up to 11 with enhanced resolution (ERES) | | |
| Sensitivity | 50Ω: 2 mV/div - 1 V/div fully variable; 1 MΩ: 2 mV - 10 V/div fully variable | | |
| DC Accuracy | ±1.0% of full scale (typical); ±1.5% of full scale, ≥ 10 mV/div (warranted) | | |
| Offset Range | 50Ω: ±1 V @ 2-98 mV/div, ±10 V @ 100 mV/div - 1 V/div; 1 MΩ: ±1 V @ 2-98 mV/div, ±10 V @ 100 mV/div - 1 V/div, ±100 V @ 1.02 V/div - 10 V/div | | |
| Offset Accuracy | ±(1.5% of offset value + 0.5% of full scale +1 mV) | | |
| Offset Accuracy (104/204Xi) only | ±(1.5% of offset value + 1.0% of full scale +1 mV) | | |
| Input Connector | ProBus ®/BNC | | |

## 3.2 Timebase System

| | |
|---|---|
| Timebases | Internal timebase common to all input channels; an external clock may be applied at the auxiliary input |
| Time/Division Range | Real time: 200 ps/div - 10 s/div, RIS mode: 20 ps/div to 100 ns/div, Roll mode: up to 1,000 s/div |
| Clock Accuracy | ≤ 5 ppm @ 25 °C (typical) (≤ 10 ppm @ 5-40 °C) |
| Sample Rate and Delay Time Accuracy | Equal to Clock Accuracy |
| Channel to Channel Deskew Range | ±9 x time/div setting, 100 ms max., each channel |
| External Sample Clock | DC to 600 MHz; 50Ω, (limited BW in 1 MΩ), BNC input, limited to 2 Ch operation (1 Ch in 62Xi), (minimum rise time and amplitude requirements apply at low frequencies) |
| Roll Mode | User selectable at ≥ 500 ms/div and ≤100 kS/s |

## 3.3 Acquisition System

| | WaveRunner 44Xi | WaveRunner 64Xi/ 62Xi | WaveRunner 104Xi/204Xi |
|---|---|---|---|
| Single-Shot Sample Rate/Ch | 5 GS/s | 5 GS/s | 5 GS/s |
| Interleaved Sample Rate (2 Ch) | 5 GS/s | 10 GS/s | 10 GS/s |
| Random Interleaved Sampling (RIS) | 200 GS/s | | |
| RIS Mode | User selectable from 200ps/div to 10ns/div ,100ps to 10ns for the 104Xi, 204Xi | | |
| Trigger Rate (Maximum) | 1,250,000 waveforms/second | | |
| Sequence Time Stamp Resolution | 1 ns | | |
| Minimum Time Between | 800 ns | | |

Sequential Segments

## 3.4 Acquisition Memory Options

| | Max. Acquisition Points (4 Ch/2 Ch, 2 Ch/1 Ch in 62Xi) | Segments (Sequence Mode) |
|---|---|---|
| Standard | 10M/20M | 5000 |
| Option VL | 12.5M/25M | 10,000 |

## 3.5 Acquisition Processing

| | WaveRunner 44Xi | WaveRunner 64Xi/62Xi | WR104Xi/204Xi |
|---|---|---|---|
| Time Resolution (min, Single-shot) | 200 ps (5 GS/s) | 100 ps (10 GS/s) | 100 ps (10 GS/s) |
| Averaging | Summed and continuous averaging to 1 million sweeps | | |
| ERES | From 8.5 to 11 bits vertical resolution | | |
| Envelope (Extrema) | Envelope, floor, or roof for up to 1 million sweeps | | |
| Interpolation | Linear or Sin x/x | | |

## 3.6 Trigger System

| | | | |
|---|---|---|---|
| Trigger Modes | Normal, Auto, Single, Stop | | |
| Sources | Any input channel, External, Ext/10, or Line; slope and level unique to each source, except Line | | |
| Trigger Coupling | DC, AC (typically 7.5 Hz), HF Reject, LF Reject | | |
| Pre-trigger Delay | 0-100% of memory size (adjustable in 1% increments, or 100 ns) | | |
| Post-trigger Delay | Up to 10,000 divisions in real time mode, limited at slower time/div settings in roll mode | | |
| Hold-off | 1 ns to 20 s or 1 to 1,000,000,000 events | | |
| Internal Trigger Level Range | ±4.1 div from center (typical) | | |
| Trigger and Interpolator Jitter: | ≤ 3 psrms (typical) | | |
| | WaveRunner 44Xi | WaveRunner 64Xi/62Xi | WR104Xi/204Xi |
| Trigger Sensitivity with Edge Trigger (Ch 1-4 + external , DC, AC, and LFrej coupling) | 2 div @ < 400 MHz<br>1 div @ < 200 MHz | 2 div @ < 600 MHz<br>1 div @ < 200 MHz | 2 div @ < 1GHz/ 2GHz<br>1 div @ < 200 MHz |
| Max. Trigger Frequency with SMART Trigger (Ch 1-4 + external) | 400 MHz<br>@ ≥ 10 mV | 600 MHz<br>@ ≥ 10 mV | 600 MHz<br>@ ≥ 10 mV |
| External trigger range | EXT/10 ±4 V; EXT ±400 mV | | |

## 3.7 Basic Triggers

| | |
|---|---|
| Edge | Triggers when signal meets slope (positive, negative, or Window) and level condition. |

## 3.8 SMART Triggers

| | |
|---|---|
| State or Edge Qualified | Triggers on any input source only if a defined state or edge occurred on another input source. Delay between sources is selectable by time or events. |
| Dropout | Triggers if signal drops out for longer than selected time between 1 ns and 20 s. |
| Pattern | Logic combination (AND, NAND, OR, NOR) of 5 inputs (4 channels and external trigger input - 2 Ch+EXT |
| TV-Composite Video | Triggers selectable fields (1, 2, 4, or 8), Positive or Negative slope, or Line (up to 1500), for NTSC, PAL, SECAM, or non-standard video (up to 1500 |

lines).

## 3.8 SMART Triggers with Exclusion Technology

| | |
|---|---|
| Glitch and Pulse Width | Triggers on positive or negative glitches with widths selectable from 600 ps to 20 s or on intermittent faults (subject to bandwidth limit of oscilloscope). |
| Signal or Pattern Interval | Triggers on intervals selectable between 1 ns and 20 s. |
| Timeout (State/Edge Qualified) | Triggers on any source if a given state (or transition edge) has occurred on another source. Delay between sources is 1 ns to 20 s, or 1 to 99,999,999 events. |
| Runt | Trigger on positive or negative runts defined by two voltage limits and two time limits. Select between 1 ns and 20 ns. |
| Slew Rate | Trigger on edge rates. Select limits for dV, dt, and slope. Select edge limits between 1 ns and 20 ns. |
| Exclusion Triggering | Trigger on intermittent faults by specifying the normal width or period. |

## 3.9 LeCroy WaveStream Fast Viewing Mode

| | |
|---|---|
| Intensity | Adjustable via front panel control |
| Number of Channels | up to 4 simultaneously |
| Max Sampling Rate | 5 GS/s (10 GS/s for WaveRunner 64Xi/62Xi,104Xi/204Xi in interleaved mode) |
| Waveforms/second (continuous) | up to 8000 waveforms/second |
| Operation | Front panel toggle between normal -Time and LeCroy WaveStream Fast Viewing Mode |

## 3.10 Automatic Setup

| | |
|---|---|
| Auto Setup | Automatically sets timebase, trigger, and sensitivity to display a wide range of repetitive signals. |
| Vertical Find Scale | Automatically sets the vertical sensitivity and offset for the selected channels to display a waveform with maximum dynamic range. |

## 3.11 Probes

| | |
|---|---|
| Probes | One PP008 per channel standard; Optional passive and active probes available. |
| Probe System; ProBus | Automatically detects and supports a variety of compatible probes. |
| Scale Factors | Automatically or manually selected, depending on probe used |

## 3.12 Color Waveform Display

| | |
|---|---|
| Type | Color 10.4" flat-panel TFT-LCD with high resolution touch screen |
| Resolution | SVGA; 800 x 600 pixels |
| Number of Traces | Display a maximum of 8 traces. Simultaneously display channel, zoom, memory, and math traces. |
| Grid Styles | Auto, Single, Dual, Quad, Octal, XY, Single + XY, Dual + XY |
| Waveform Styles | Sample dots joined or dots only |

## 3.13 Analog Persistence Display

| | |
|---|---|
| Analog and Color-Graded Persistence | Variable saturation levels; stores each trace's persistence data in memory. |
| Persistence Selections | Select analog, color, or three-dimensional. |
| Trace Selection | Activate persistence on all or any combination of traces. |
| Persistence | Aging time select from 500 ms to infinity. |
| Sweeps Displayed | All accumulated, or all accumulated with last trace highlighted. |

## 3.14 Zoom Expansion Traces

Display up to 4 Zoom/Math traces

## 3.15 Internal Waveform Memory

M1, M2, M3, M4 Internal Waveform Memory (store full-length waveform with 16 bits/data point) or store to any number of files limited only by data storage media.

## 3.16 Setup Storage

| | |
|---|---|
| Front Panel and Instrument Status | Store to the internal hard drive, over the network, or to a USB-connected peripheral device. |

## 3.17 Interface

| | |
|---|---|
| Remote Control | Via Windows Automation, or via LeCroy Remote Command Set |
| GPIB Port (Optional) | Supports IEEE - 488.2 |
| Ethernet Port | 10/100Base-T Ethernet interface (RJ-45 connector) |
| USB Ports | 5 USB 2.0 ports (one on front of instrument) supports Windows-compatible devices. |
| External Monitor Port | Standard 15-pin D-Type SVGA-compatible DB-15; connect a second monitor to use dual-monitor display mode. |
| Serial Port | DB-9 RS-232 port (not for remote oscilloscope control) |

## 3.18 Auxiliary Input

| | |
|---|---|
| Signal Types | Selected from External Trigger or External Clock input on front panel |
| Coupling | 50Ω: DC, 1 MΩ: AC, DC, GND |
| Maximum Input Voltage | 50Ω: 5 Vrms, 1 MΩ: 400 V max. (Peak AC: ≤ 5 kHz + DC) |

## 3.19 Auxiliary Output

| | |
|---|---|
| Signal Type | Trigger Enabled, Trigger Output. Pass/Fail, or Off |
| Output Level | TTL,~3.3 V |
| Connector Type | BNC, located on rear panel |

## 3.20 General

| | |
|---|---|
| Auto Calibration | Ensures specified DC and timing accuracy is maintained for 1 year minimum. |
| Calibrator | Output available on front panel connector provides a variety of signals for probe calibration and compensation. |
| Power Requirements | 90-264 V rms at 50/60 Hz; 115 V rms (±10%) at 400 Hz, Automatic AC Voltage Selection Installation Category: 300V CAT II; Max. Power Consumption: 300 VA/300 W; 250 VA/250 W for WaveRunner 62Xi |

## 3.21 Environmental

| | |
|---|---|
| Temperature: Operating | +5 °C to +40 °C |
| Temperature: Non-Operating | -20 °C to +60 °C |
| Humidity: Operating | 5% to 80% RH (non-condensing) up to 30 °C, Upper limit derates linearly to 45% RH (non-condensing) at 40 °C |
| Humidity: Non-Operating | 5% to 95% RH (non-condensing) as tested per MIL-PRF-28800F |
| Altitude: Operating | 3,048 m (10,000 ft.) max at ≤ 25 °C |
| Altitude: Non-Operating | 12,190 m (40,000 ft.) |

## 3.22 Physical

| | |
|---|---|
| Dimensions (HWD) | 260 mm x 340 mm x 152 mm (excluding feet) 10.25" x 13.4" x 6" |
| Net Weight | 6.8 kg. (15 lbs.) |

## 3.23 Certifications

CE Compliant, UL and cUL listed; Conforms to EN 61326, EN 61010-1, UL 61010-1 2nd Edition, and CSA C22.2 No. 61010-1-04.

## 3.24 Warranty and Service

3-year warranty; calibration recommended annually. Optional service programs include extended warranty, upgrades, calibration, and customization services.

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# 4. Theory of Operation

## 4.1 System Block Diagram

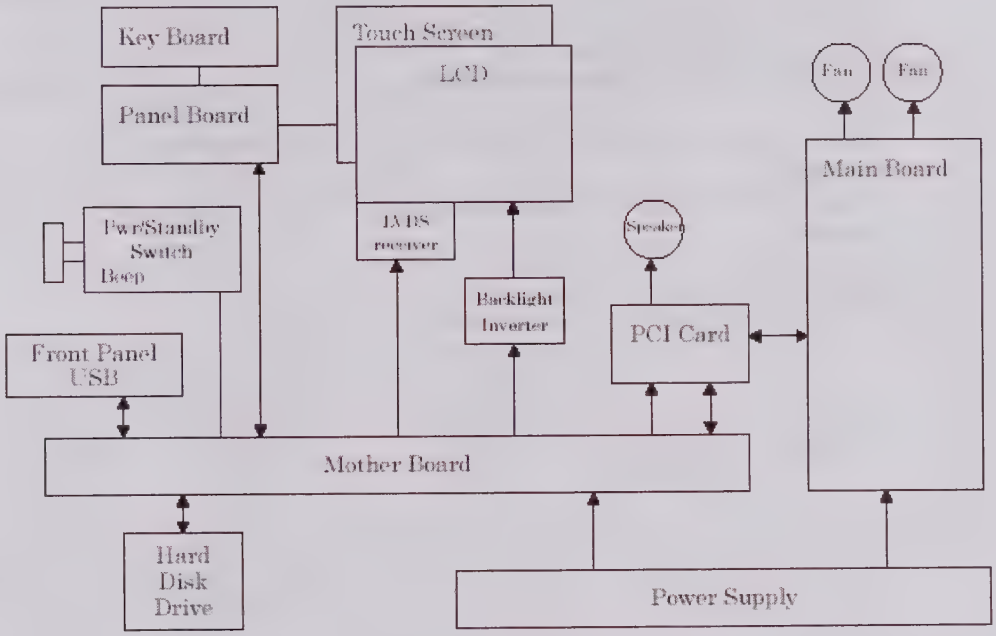



Figure 4-1 WaveRunner Block Diagram

## 4.2 Main Board

The main board is divided into the following sections:

- **Front End**
  Based on high impedance buffer, variable gain amplifier and differential amplifiers.
- **Analog to Digital Converter**
  Based on the HAM631 and the relay switchyard to combine the input channels.
- **Trigger**
  Based on the Hybrids HTR420 discriminator & MST429A smart trigger.
- **Time Base**
  Based on the MCG426 clock generator & MTB411A controller.
- **Calibrator**
- **SCAN DAC**
- **Main Board Control**

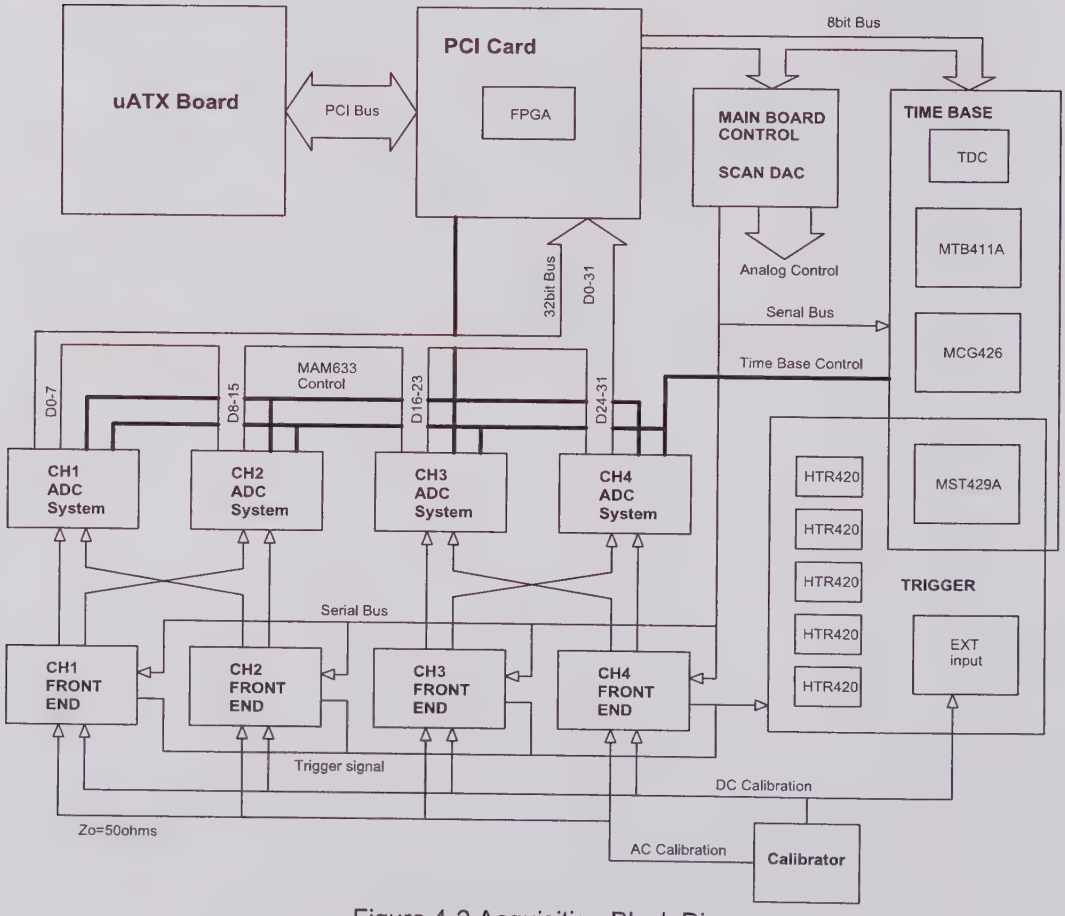



Figure 4-2 Acquisition Block Diagram

### 4.2.1 Front End

The front end processes an analog signal for ADC and trigger, consists of 1M ohms attenuators, high impedance buffer, 200 ohms attenuator, variable gain amplifier SA5209D and differential amplifiers.

The main functions of the Front end without the amplifiers are:

- Four channels operation, calibration with Software control.
- Input protection (clamp + thermal detection) and coupling (AC, DC, 1MΩ, 50Ω).
- Attenuator by 5, by 10, by 50, by 100 & by 500.
- Offset control of ±1V.
- Detection of 50Ω over loading.
- Input of signal for DC calibration and skew calibration.

The main functions of SA5209D and differential amplifiers are:

- Amplitude normalization for the ADC system : at the BNC the dynamic range is 16 mV to 80V FS (full scale) and the ADC/TRIG system input is 500 mV differential.
- Fine adjustment of gain and variable control.
- Band width limiter of 20MHz, 200MHz.
- Switch for channel combine mode.

**Control**

Relay control

The relay of the attenuator is set by selecting the input coupling and the gain as shown in the table below.

All relays are driven with +5V/0V.

Input coupling

| Control port | Relay | GND | 1M,DC | 1M,AC | 50,DC |
|---|---|---|---|---|---|
| CAL | RL2 | H | L | L | L |
| 1M/*50 | RL1 | H | H | H | L |
| AC/*DC | RL5 | H | L | H | L |
| 1/*10 | RL3 | H | X | X | X |
| 1/*100 | RL4 | L | X | X | X |

Switch of attenuator

| Control port | Relay | 2mV-49mV | 50mV-0.49V | 0.5V-10V |
|---|---|---|---|---|
| 1/*10 | RL3 | H | L | L |
| 1/*100 | RL4 | H | H | L |

### Divide gain

The gain ratio in each block and input range is a table below.
At the BNC the dynamic range is 16 mV to 80V FS (full scale) and the output is 500 mV differential (HAD631 input).

| | Range V/div | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Block | 2mV | 5mV | 10mV | 20mV | 50mV | 100mV | 200mV | 500mV | 1V | 2V | 5V | 10V |
| ATT 1/*10 | 1 | 1 | 1 | 1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| ATT 1/*100 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 |
| ATT 1/5 | 1 | 1 | 1 | 0.2 | 1 | 1 | 0.2 | 1 | 1 | 0.2 | 0.2 | 0.2 |
| SA5209D | 31.25 | 12.5 | 6.25 | 15.62 | 1.25 | 6.25 | 15.62 | 1.25 | 6.25 | 15.62 | 6.25 | 3.125 |
| Total(ratio) | 31.25 | 12.5 | 6.25 | 3.125 | 1.25 | 0.625 | 0.3125 | 0.125 | 0.0625 | 0.03125 | 0.0125 | 0.00625 |

### Analog control voltage

| Circuit name | signal level | Signal name |
|---|---|---|
| CHx OFFSET | +/-4V | Offset control signal for Front End |
| CHx GAIN | +/-4V | SA5209D gain control signal |
| CHx OS ADJ | 0 to +4V | Offset control signal for differential amplifiers |
| INT CAL | -6V to +6V | Signal each CH commonness for calibration |

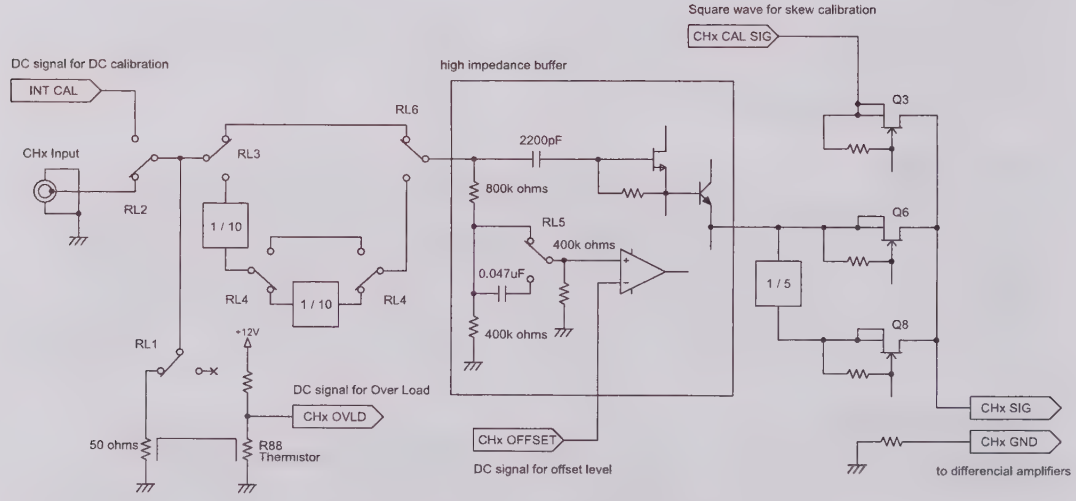



Figure 4-3 Front End Block Diagram 1

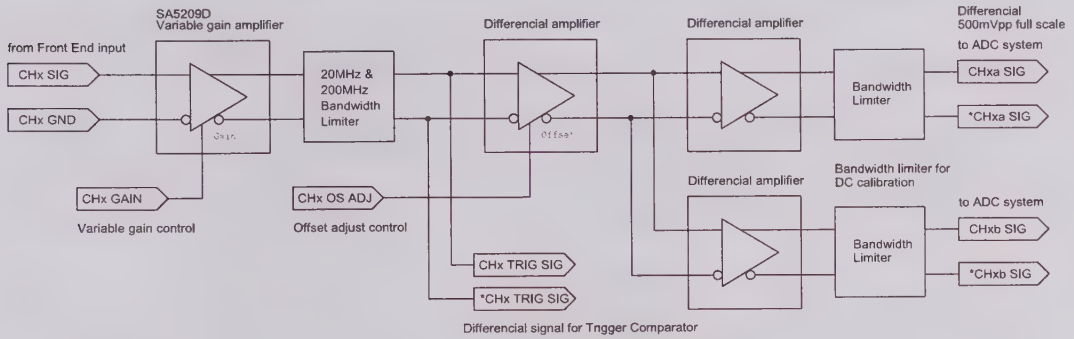



Figure 4-4 Front End Block Diagram 2

### 4.2.2 Analog to Digital Converter

The analog to digital converter system does the signal conversion to 8 bits, using the HAM631:
The system has the relay switchyard to combine the input channels.

- **HAM631**
  Hybrid ADC 1GS/s with 4Mb memory. It consists of MAD442 and MAM633.
  Provide 83 MHz clock for memory and refresh for DRAM.

**Analog Control voltage**

| Circuit name | signal level | Signal name |
|---|---|---|
| CHx ADGAN | 0 to +4V | Adjust ADC gain (+/-15%) |
| CHx ADOFS | 0 to +4V | Adjust ADC offset (+/-100mV) |
| CHx ADDLY | 0 to +4V | Adjust ADC sampling delay (+/-250ps) |

These are mainly used on channel combine mode.

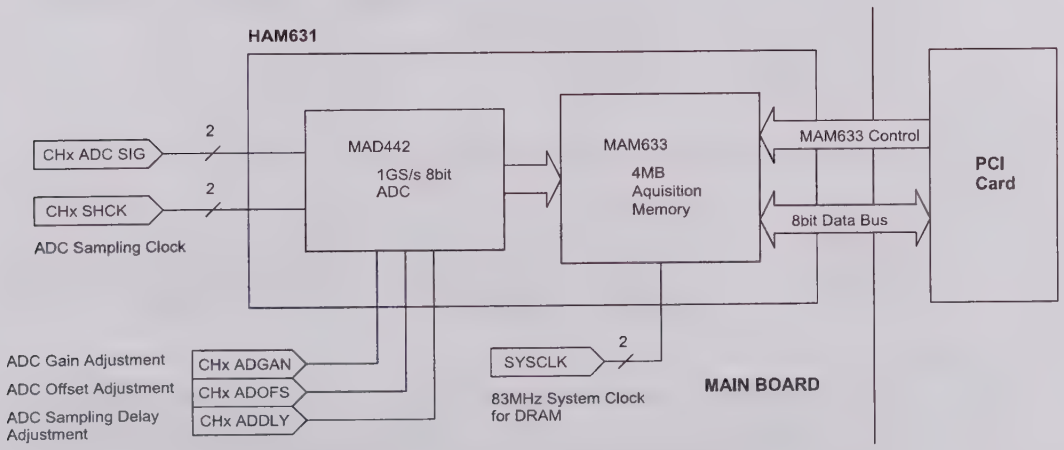



Figure 4-5 HAM631 System Architecture

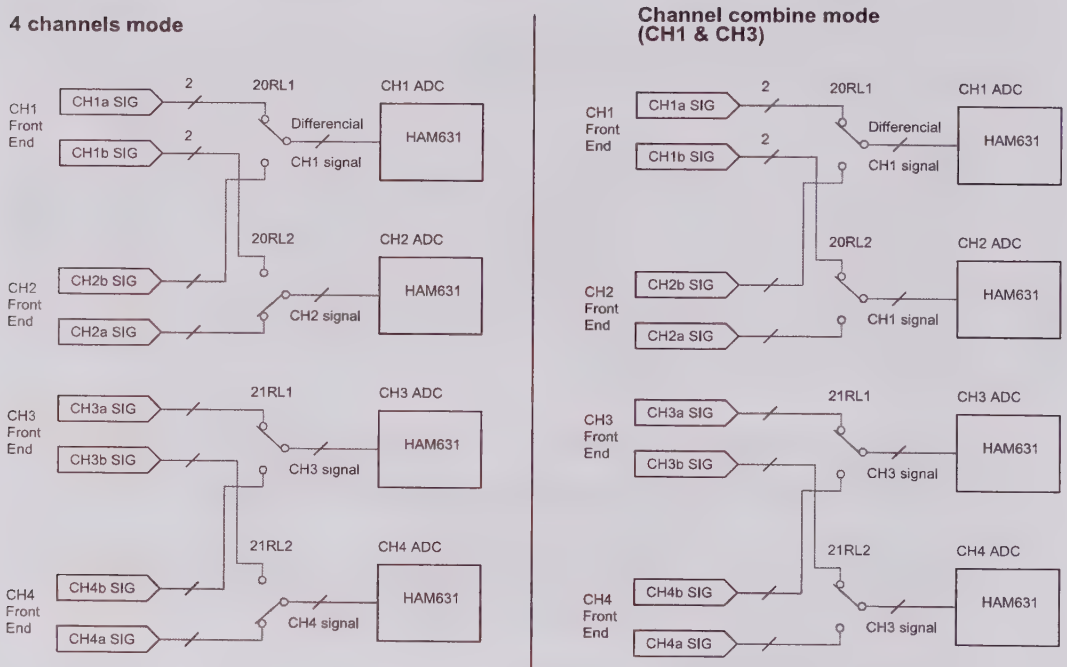



Figure 4-6 4 & 2 Channel Mode

## 4.2.3 Trigger

**HTR420**

The main function of HFE420 are:

- Generation of trigger signal (analog input and digital output) with comparator
- Setting of trigger level (TRIG,VALIDATE)
- Setting of trigger coupling (DC,AC,LFREJ,HFREJ,HF)
- Setting of slope (+,-,WINDOW)

The different trigger couplings using HTR420 are :

- DC
- AC : cut off frequency is almost 7.5 Hz.
- LF REJ : single pole high pass filter with a cut off frequency at 50 kHz.
- HF REJ : single pole low pass filter with a cut off frequency at 50 kHz.
- HF : frequency divider by four for high frequency signal.

**TV Trigger**

Each channel has a pick-off after the HTR420. Selected trigger source goes to commercial chip (LM1881) via AGC amplifier and provides three outputs (Composite Sync. Output, Vertical Sync. Output, and ODD/EVEN output) to the MST429A.

**MST429A**

The main function of MST429A are:

- generates main trigger signal for Time Base system

The trigger function of MST429A are:

- Single source trigger,
  - Standard trigger,
  - Hold off by Time
  - Hold off by Events,
  - Pulse width
  - Interval
- Multiple source trigger,
  - State qualified,
  - Edge qualified

**Analog Control voltage**

| Circuit name | signal level | Signal name |
|---|---|---|
| CHx TRIG LVL1 | +/-4V | Trigger level control signal |
| CHx TRIG LVL2 | +/-4V | Trigger level control signal for smart trigger/window |
| CHx HYST | 0 to +4V | Trigger hysteresis control signal |

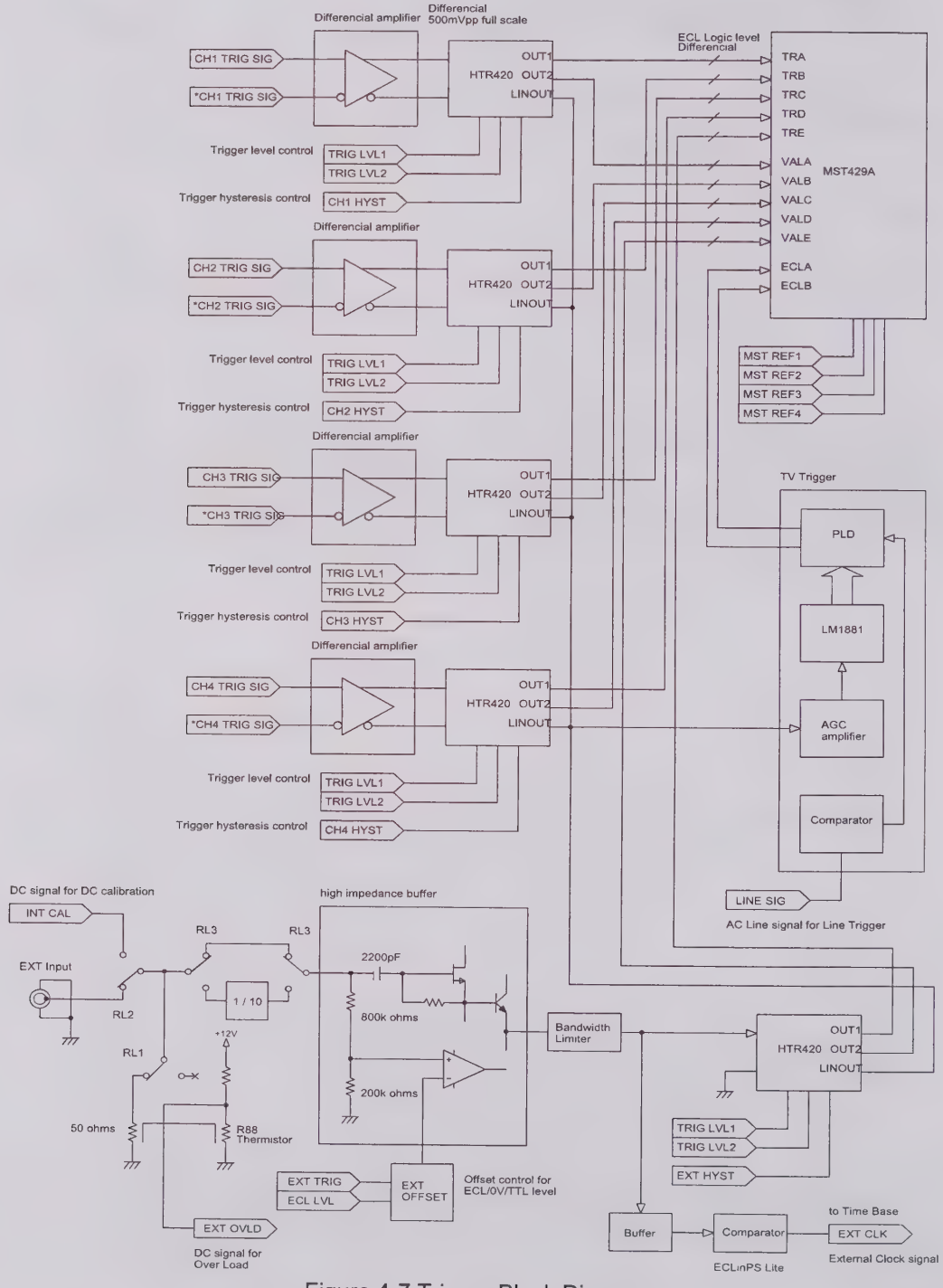



Figure 4-7 Trigger Block Diagram

### 4.2.4 Time Base

The time base includes four circuits:

- **MCG426**: generates sampling clocks: 12.5 MHz up to 2GHz
  generates clocks for the MTB411
  interleaves sampling clocks to increase sampling rate and memory depth.
- **MTB411A**: Time Base System
  Trigger circuitry
  Main oscillator circuitry
  Frequency divider for a Probe Calibrator
- **TDC**: Time to Digital Converter interpolator and Real Time computation
- **MST429A**: generates main trigger signal for Time Base system.

#### Analog Control voltage

| Circuit name | signal level | Signal name |
|---|---|---|
| MST REF1 | +/-4V | Reference signal for analog time of Smart trigger |
| MST REF2 | +/-4V | Reference signal for analog time of Smart trigger |
| MST REF3 | +/-4V | Reference signal for analog time of Smart trigger |
| MST REF4 | +/-4V | Reference signal for analog time of Smart trigger |
| TDC ADJ | 0 to +4V | TDC gain control signal |

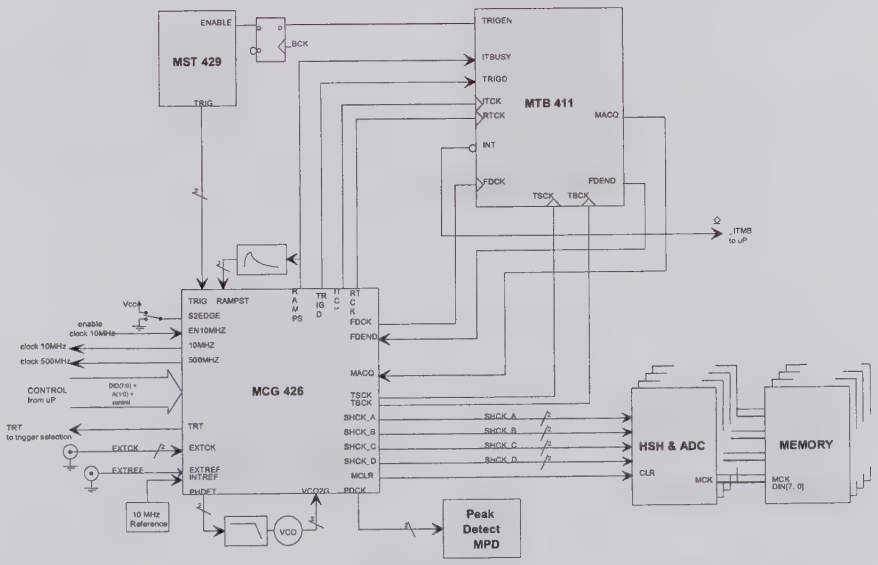



Figure 4-8 Time Base Block Diagram

### 4.2.5 Calibrator

The main functions of the Calibrator are:

- Probe calibration signal output.
- DC calibration signal output.
- Skew calibration signal output.

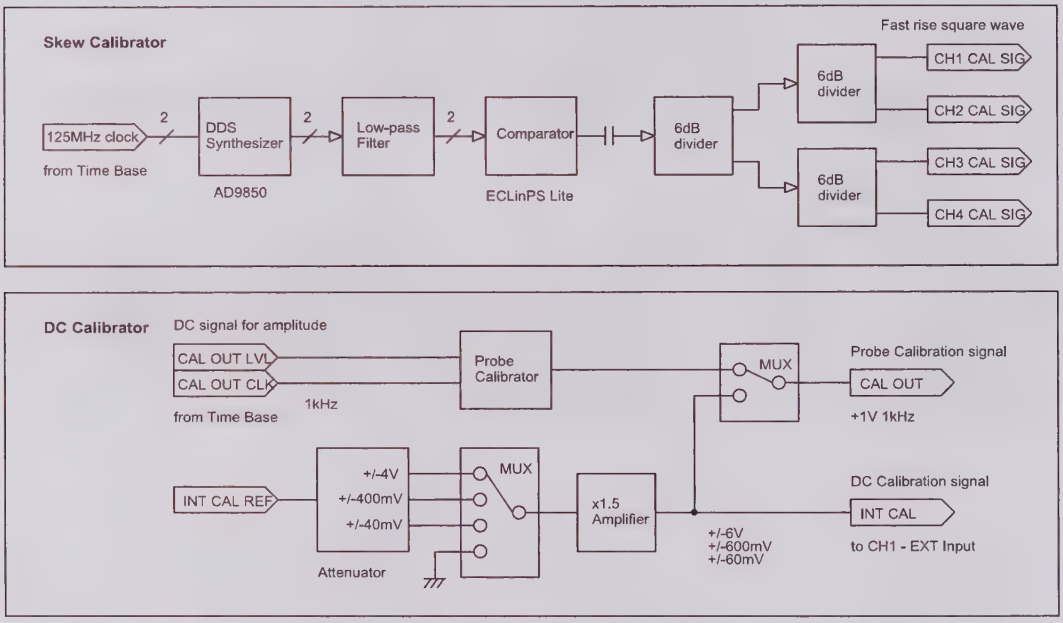



Figure 4-9 Calibrator Block Diagram

### 4.2.6 SCAN DAC

The main functions of the SCAN DAC are:

- 16 bit precision DAC with uP system.
- 24 analog control signal outputs.
- +/-4V dynamic range outputs.
- 16 ADC inputs for Probe sense, overload detection and so on.

### 4.2.7 MAIN BOARD CONTROL

The main functions of MAIN BOARD CONTROL are:

- 3 wire Serial Bus for serial device control.
- IIC Bus for EEPROM, Thermometer and ProBus system.
- 16 Analog control outputs using 10 bit DAC.
- 12 Analog control outputs using 8 bit DAC.
- Interface between Main Board and PIC Card.

## 4.3 Computer

The WaveRunner processor is an Celeron M processor 1.3 GHz.
This motherboard was designed for embedded system.

### 4.3.1 Operating System

The system uses Microsoft Windows XP embedded as the operating system. The operating system license can be found on the rear panel of the instrument.

### 4.3.2 Memory

The standard memory configuration for a WaveRunner is 512MB, consisting of 1 piece of 64M x64 Bit PC-2100 DDR DIMM.

### 4.3.3 Interfaces

The standard interfaces provided by the Motherboard to external are SVGA, Audio, Ethernet, RS-232, Centronics, three USBs(side 2, front 1), PS/2 Keyboard and PS/2 Mouse. Also one USB and IDE port provided by the Motherboard are used inside the unit for Front panel and HDD.

### 4.3.4 Storage Devices

The system has an internal hard drive of at least 30 GB in size. 10 GB is allocated for LeCroy use, 16 GB is in a user partition for the saving of panel setups, waveform memory, hard copies, application programs, user data, etc. The balance is allocated as invisible partition for system recovery data

### 4.3.5 Video port

The Mother board has an on-board video display processor with a LVDS output as well as the ability to drive a rear panel external display. This external port is enabled on power up if it an external monitor is sensed. If the monitor is connected after the initial power on, the power to the instrument must be cycled in order for this monitor to operate.

## 4.4 PCI Card

The PCI card is the interface between the PCI bus on the processor card and the rest of the system (acquisition system and amplifier for speaker). It has the following interfaces:

- PCI interface (32 bit 33MHz bus with bus mastering capability)
- Acquisition data interface using 32bit local bus.
- Acquisition control interface using 8bit local bus.
- Dallas OneWire interface and chip for scope id.
- Audio amplifier for internal speaker.

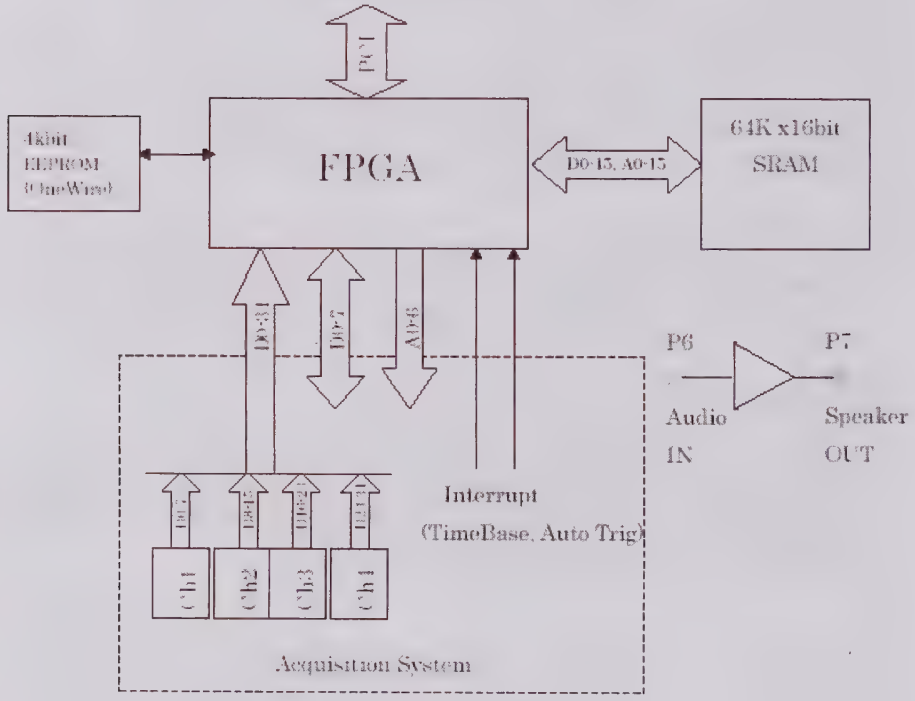



Figure 4-10 PCI Card Block Diagram

### 4.4.1 PCI Interface

The PCI interface is implemented with a Xilinx FPGA. It is a 32 bit, 33 MHz bus master that allows the PCI card to take control of the PCI bus and push data directly into the processor memory without requiring the direct involvement of the processor. In readout mode, the FPGA reads the data and puts it in the correct time order for the processor memory. The FPGA also has a special readout mode to access the acquisition data in roll mode, store the data, and then transfer this data in blocks to the processor memory. This implementation is the most complicated but is needed in order to maximize the PCI throughput.

### 4.4.2 Local bus for acquisition

The acquisition interface consists of 2 local buses to read out acquisition data and to control the main board.

#### 4.4.2.1 Control

All resource on main board is controlled through 8bit local bus.

#### 4.4.2.2 Acquisition Data

32bit local bus is used to access the acquisition memories. Each 8bit is connected to each channel's memories directly. (bit0-7 is connected to ch1, bit8-15 is connected to ch2, bit16-23 is connected to ch3 and bit24-31 is connected to ch4)

### 4.4.3 Dallas OneWire Interface

The Dallas onewire interface is controlled by FPGA. The 4kbits EEPROM is connected to this interface. This device has unique id to generate scope id.

### 4.4.4 Audio amplifire

The audio amplifier to drive internal speaker is on PCI board. This is independent from other PCI function.

## 4.5 Front Panel

The front panel consists of two assemblies, the panel board and the key board assembly.

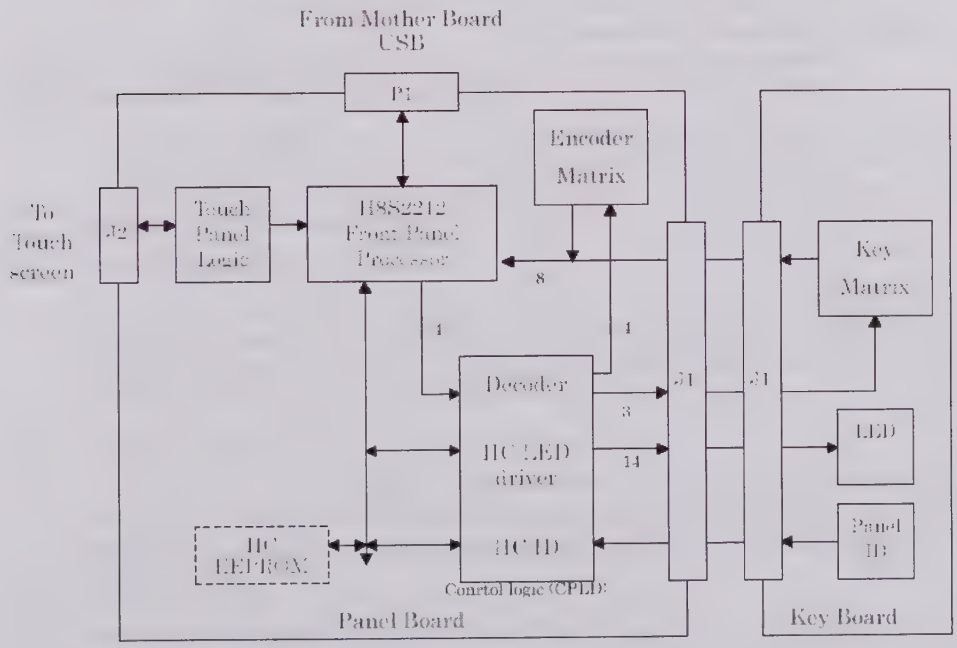



Figure 4-11 Front Panel Block Diagram

### 4.5.1 Key board

The front panel assembly consists of the panel board PCB, the panel board metal,the elastomeric keypad and the key board PCB. The key board PCB connects to the panel board assembly which is connected to the mother board by USB. The key board has the LED's which illuminate some of the front panel buttons and has trace patterns which act as switches when the elastomeric keypad shorts the traces together in response to a key press.

The key board has configuration jumper which must be selected based on the identification of the front panel (2 channel model or 4 channel model).

### 4.5.2 Panel Board

Panel board consists of rotary encoder function and touchscreen function.

The encoder status, the front panel key status and the touch panel status is read by the front panel processor, the H8S2212. Power for the panel board comes from the cable of the USB.

#### 4.5.2.1 Encoders

The panel board contains all of the rotary encoders. There are two different types of encoders on this assembly, some have a push switch, others do not. The V/Div and timebase use encoders that do not have push switch, the rest of the encoders have a push switch. The encoders contain two switches, they are not potentiometers. The software can determine the direction and speed the encoder is turning based on the order and frequency of make and break connections of these internal switches.

#### 4.5.2.2 Touchscreen Interface

Provides a control interface to a 4-wire resistive touchscreen. The pointing location is measured by 4 A/D convertors in the front panel processor.

## 4.6 Display and Touchscreen

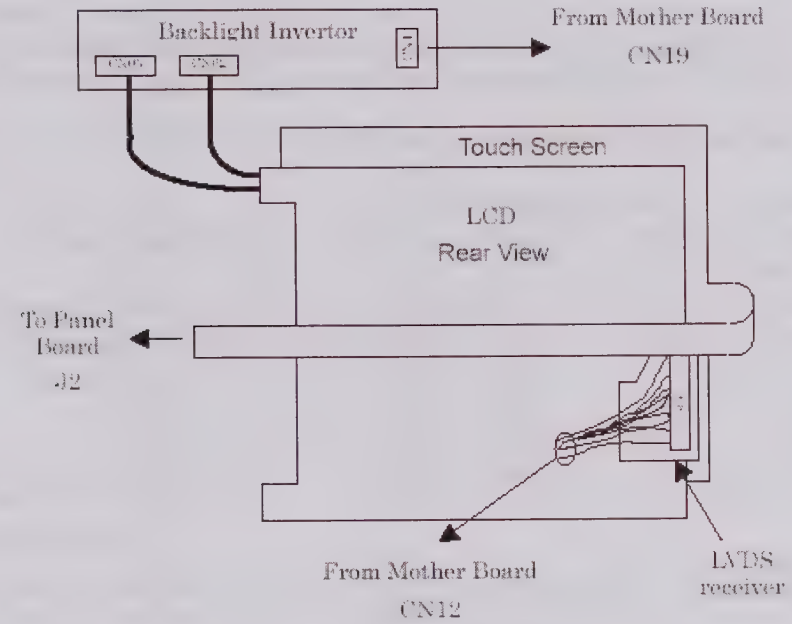



Figure 4-12 Display & Touchscreen Block Diagram

### 4.6.1 Color LCD Module

The display module is an SHARP TFT (thin film transistor) active matrix color liquid crystal display (LCD) module comprising amorphous silicon TFT attached to each signal electrode, a driving circuit and a backlight. The 26cm diagonal display area contains 800x600 pixels (SVGA) and can display 262144 colors simultaneously.

### 4.6.2 Backlight Inverter

The inverter which supplies power to the LCD's backlight is supplied with +12V from the Mother board, it then converts this to 1000-2000V AC to drive the CCFT (Cold Cathode Fluorescent Tube). There is also a signal from the Mother board which controls the On/Off of the backlight.

### 4.6.3 Touch Screen

The touch screen is a 4 wire resistive touch screen. It must be calibrated so that software can determine where a touch corresponds to a position on the screen. This calibration is done at four points and can be invoked through the Utilities menu.

### 4.6.4 LVDS receiver

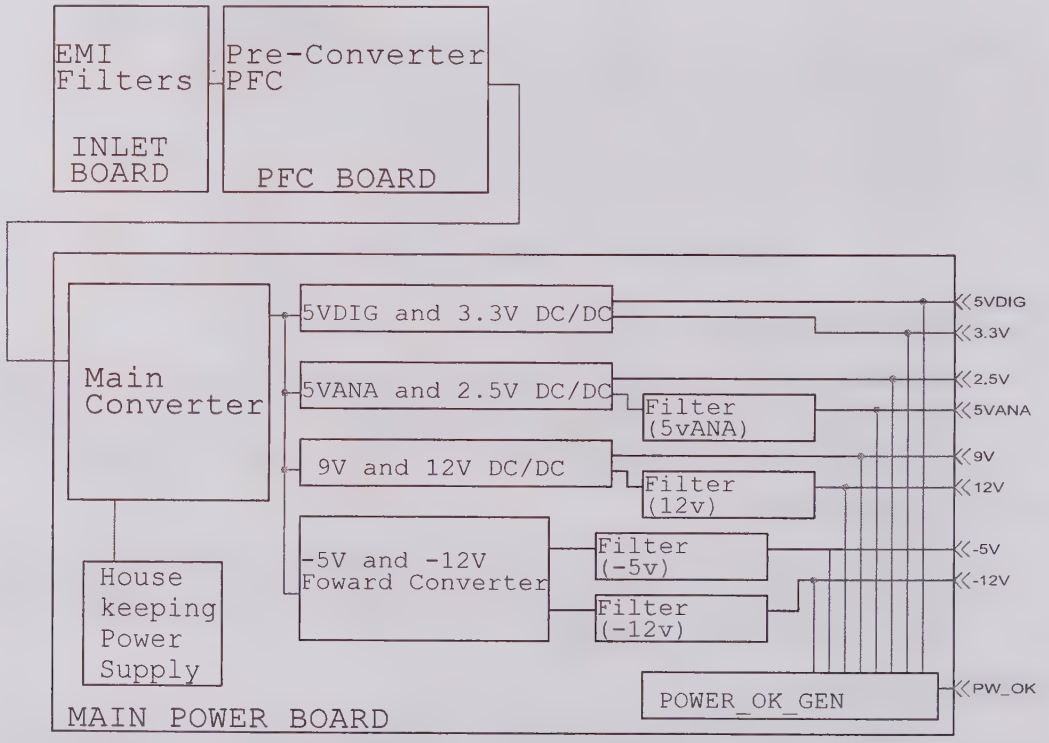
Mother board has LVDS output for LCD. LVDS receiver receive the LVDS signal from Mother board, it then converts this to 18bits RGB (each color has 6bits depthfor input type of LCD module.

## 4.7 Power Supply

Do not touch any electric parts inside the power supplies during operation as the primary side of the power unit has many high voltage portions to ground.

Power Supply Unit comprises of INLET BOARD, PFC BOARD and MAIN BOARD.

The INLET BOARD includes EMI Filters.
The PFC BOARD includes Pre-converter, which is operated Power Factor Correction.
The MAIN BOARD includes Main Converter (off line), House Keeping Power Supply, Post Converters, Filters, Power OK Generater circuit and internal Bias Supply Circuits.




Solid Line Blocks represent Daughter Boards.

Figure 4-13 Power Supply Block Diagram

### 4.7.1 Input Voltages

The power supply supports a wide ranges of inputs, 90-132 V AC (45-65HZ, 360-440Hz) and 90-264V AC (45-65Hz) are allowed.

### 4.7.2 Output Voltages

The power supply makes several output voltages:

| OUTPUT VOLTAGE | "TOTAL" REGULATION BAND | Min. Load | Typ. Load | Max. Load | CAPACITIVE LOADING | |
|---|---|---|---|---|---|---|
| | | | | | Minimum Capacitance | Maximum Capacitance |
| +5.0Vana (RS) | +/-1% | 0.1A | 4.0A | 4.2A | 1200μF | 1800μF |
| -5.0V (RS) | +/-1% | 1.0A | 5.0A | 5.25A | 1200μF | 1600μF |
| +9.0V | +/-2% | 0.1A | 0.4A | 0.5A | 330μF | 390μF |
| +2.5V | +/-5% | 0.1A | 1.0A | 1.4A | 1400μF | 2000μF |
| +12.0Vana | +/-1% | 0.1A | 0.16A | 1.16A | 330μF | 560μF |
| -12.0V | +/-2% | 0.1A | 0.62A | 1.7A | 330μF | 560μF |
| +5.0Vdig | +/-5% | 0.1A | 3.1A | 5.5A | 2400μF | 10000μF |
| +12Vdig | +/-5% | 0.1A | 1.0A | 1.24A | 500μF | 1000μF |
| 3.3V | +/-5% | 0.1A | 2.0A | 3.0A | 4000uF | 6000uF |
| 5.0V(stand) | +/-5% | 0.1A | 0.1A | 1.0A | | |

Note: RS represent Remote Sense.

### 4.7.3 Basic Operation

The power supply utilizes 5 converter, 5 synchronous step- down switching regulator and step-down switching regulator.

#### 4.7.3.1 Pre-converter

Power Factor Correction (PFC) circuit. It uses a Critical Mode Boost Converter topology switching and using MosFETs as the primary switches. The output of the PFC Converter is regulated to 385VDC.

#### 4.7.3.2 Main Converter

The converters are like dual-switch half-bridge converters switching at approximately 88KHz and utilizing the module integrated controller and two MosFETs as the primary switches. Output is regulated using a post switching regulation scheme. The output has its own raw voltage provided on its own separate winding on the transformers. The output is regulated to 24V secondary bus voltage,.

#### 4.7.3.3 House Keeping Power Supply

It is a fly back converter switching at approximately 80 kHz. The bias supply also provides other voltages for internal housekeeping. The bias supply is "ON" whenever AC is present. +5VSB is provided from an step-down switching regulator.

#### 4.7.3.4 +5VDIG and 3.3V DC/DC(Daughter Board)

Dual 2-phase synchronous step-down switching regulator is used for the +5Vdig and +3.3V supply.

#### 4.7.3.5 +5VANA and 2.5V DC/DC (Daughter Board)

Dual 2-phase synchronous step-down switching regulator is used for the +5.0Vana and 2.5V supply.

#### 4.7.3.6 +9 and 12V DC/DC (Daughter Board)

Step-down switching regulator is used for the +9.0V supply. Synchronous step-down switching regulator is used for the +12V supply.

#### 4.7.3.7 -5V and –12V Forward converter

This converter is used for the –5.0V supply. There is also a linear regulator which supplies the –12V supply.

#### 4.7.3.8 Filter Circuits (Daughter Boards)

The Filter circuits are implemented for analog outputs ;+5.0V,+12.0V,-5.0V and –12.0V.

### 4.7.4 Connector Assignments

The power supply connectors are arranged as follows:

INLET BOARD

| Reference | Supplied BOARD | Connector | Pin# | Voltage /Function | Comment |
|---|---|---|---|---|---|
| 1CN2 | PFC BOARD | 5566-2A | Total 2 | Input AC Line | |

PFC BOARD

| | | | | | |
|---|---|---|---|---|---|
| 2CN2 | INLET BOARD | 5566-2A | Total 2 | Input AC Line | |
| 2CN3 | MAIN BOARD | 5566-2A | 1 | 385VDC | |
| | | | 2 | Primary Return | |
| 2CN1 | MAIN BOARD | 5267-3A | 1 | 18.5VDC | |
| | | | 2 | Primary Return | |
| | | | 3 | Traiac Bias | |
| 2CN4 | MAIN BOARD | 5267-2A | 1 | Line | |
| | | | 2 | GND | |

MAIN BOARD

Primary

| | | | | | |
|---|---|---|---|---|---|
| 3CN1 | PFC BOARD | 5267-3A | 1 | 18.5VDC | |
| | | | 2 | Primary Return | |
| | | | 3 | Triac Bias | |

| | | | | | |
|---|---|---|---|---|---|
| 5CN2 | PFC BOARD | 5566-2A | 1 | 385VDC | |
| | | | 2 | Primary Return | |

Secondary

| Reference | Supplied BOARD | Connector | Pin# | Voltage /Function | Comment |
|---|---|---|---|---|---|
| CN9 | EXT BOARD | 5566-2A | 1 | 24V | Bus Voltage |
| | | | 2 | GND | |

| | | | | | |
|---|---|---|---|---|---|
| 5CN1 | EXT BOARD | 5267-3A | 1 | 24V | To printer |
| | | | 2 | N.C | |
| | | | 3 | GND | |

| | | | | | |
|---|---|---|---|---|---|
| CN2 | Main Board | 51067 | 1,2 | +5.0V | |
| | | | 3,6 | GND | |
| | | | 4,5 | -5.0V | |
| | | | 7,8 | +2.5V | |

| | | | | | |
|---|---|---|---|---|---|
| CN3 | Main Board | 51067 | 1 | +12.0V | |
| | | | 2,4 | GND | |
| | | | 3 | +9.0V | |
| | | | 5 | -12.0V | |

| | | | | | |
|---|---|---|---|---|---|
| CN4 | Main Board | 5268-07A | 1 | -12.0V | F.B –12.0V |
| | | | 2 | +12.0V | F.B +12.0V |
| | | | 3 | -5.0V | F.B –5.0V |
| | | | 4 | +5.0V | F.B +5..0V |
| | | | 5 | LINE | Line tiger Signal |
| | | | 6 | BAT EN | Battery EN. |
| | | | 7 | BAT VS | Battery V.S. |

| | | | | | |
|---|---|---|---|---|---|
| CN5 | Main Board<br>FAN MOTOR | 5568-02A | 1 | +12Vdig | |
| | | | 2 | GND | |

| Reference | Supplied BOARD | Connector | Pin# | Voltage /Function | Comment |
|---|---|---|---|---|---|
| CN6 | UATX-Board | 5566-20A | 1,2,11 | 3.3Vdig | |
| | | | 3 | GND | |
| | | | 4 | 5.0Vdig | |
| | | | 5,7,13 | GND | |
| | | | 6,19,20 | 5.0Vdig | |
| | | | 8 | PWR_OK | TTL level |
| | | | 9 | +5.0Vstb | Standby Power |
| | | | 10 | +12.0Vdig | |
| | | | 12 | -12Vdig | |
| | | | 15,16,17 | GND | |
| | | | 14 | PS_ON# | <0.8V:ON/>2V:OFF |
| | | | 18 | -5.0Vdig | |

| | | | | | |
|---|---|---|---|---|---|
| CN11 | PFC BOARD | 5267-02A | 1 | LINE | |
| | | | 2 | GND | |

| | | | | | |
|---|---|---|---|---|---|
| CN7 | EXT Board | 5267-06A | 1 | GND | |
| | | | 2 | REMOTE_ON | |
| | | | 3 | BAT VS | |
| | | | 4 | BAT EN | |
| | | | 5 | Vaux | |
| | | | 6 | 5Vstd | |

| | | | | | |
|---|---|---|---|---|---|
| CN10 | EXT Board | 5267-02A | 1 | 24V | External OUT |
| | | | 2 | GND | |

### 4.7.5 Output Voltage Adjustment Range

Each output voltage has an adjustment range of the nominal Vset voltage as specified in the table. The adjustments are clearly labeled and accessible from the top of the Power Supply. Turning adjustment potentiometers clockwise increases the absolute value of output voltages.

### 4.7.6 +5VSB Standby Supply Rail

+5VSB is a standby supply output that is active whenever the AC power is present. It provides a power source for the processor standby circuits that must remain operational when the other main DC output rails are in a disabled state. The 5VSB output is capable of delivering up to 0.5A continuously with the fan not operating.

### 4.7.7 Control

The following control signals are required.

#### 4.7.7.1 Output Enable OUTPUT-EN/ (active low)

This is an active low signal which comes from the processor board that turns on (enables) all of the power supply DC outputs.

#### 4.7.7.2 Line Frequency Synchronization Output Signal (LFS)

The LFS signal is safety-isolated from the primary circuits of the power supply. The LFS signal is a digital signal (TTL levels) that toggles at each zero-crossing of the AC line input.

#### 4.7.7.3 PWR_OK signal

PWR_OK is a “power good” signal. It is asserted high by the power supply a minimum of 100ms after all Secondary Outputs are above the minimum voltage as specified by the lower limit of the regulation band and the AC line is present. The PWR_OK rise time is <= 10ms. In the case of AC line disconnection or drop-out, the PWR_OK signal goes low when at least one of Secondary Outputs drop out of regulation.

### 4.7.8 Over-Current Protection

All outputs are protected against damage due to overloads or short circuits. Short circuit current levels for any output, unless specified below, will not exceed 125% of maximum current for that output.
Each output has independent current limiting, that is the over-current of any of these outputs will not cause any other output except –5.0V Output. If –5.0V output will short, -12.0V output reduces output voltage. The over current circuitry is latch type. Whenever Over-Current protection occur, all Outputs shut down to protect Circuitry damage. –5V output only have over-current adjustment value(6A) and adjustment potentiometer.

### 4.7.9 Over-Temperature Protection

The power supply will shut down before any damage occurs from over-temperature. This is true independent of the cause of the over-temperature condition (i.e. blocked power supply cooling fan, excessive ambient temperature, etc.) When the power supply restart , the power supply must remove AC Line for a few minutes and remove the cause of the over-temperature condition.

### 4.7.10 Over-Voltage Protection

Over-voltage protection is required to reduce the likelihood of damage to system components in the event of a single point fault within the power supply. All outputs incorporate an over-voltage protection limited to less than 135% of the nominal Vset values. When the power supply restart , the power supply must remove AC Line for a few minutes and remove the cause of the over-Voltage condition.

## LeCroy Digital Storage Oscilloscope

## Performance Certificate

WaveRunner Xi Manual Performance Test Procedure Version E – Nov. 2008

Model_____ Serial Number_____ Customer_____

Software Version_____

Inspection Date_____ Next Due_____

Temperature_____ Humidity_____%

Tested By_____ Report Number_____

Place of Inspection_____

Condition found_____ Condition Left_____

Approved By_____

## Test Equipment Used

| Instrument | Model | S/N | Cal Due Date |
|---|---|---|---|
| Signal Generator Radio Frequency | _____ | _____ | _____ |
| Signal Generator Audio Frequency | _____ | _____ | _____ |
| Voltage Generator DC Power Supply | _____ | _____ | _____ |
| Digital Multimeter | _____ | _____ | _____ |
| Power Meter | _____ | _____ | _____ |
| Power Sensor | _____ | _____ | _____ |

Traceable to_____

**Table 1: WaveRunner Xi Test Report**

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| Coupling | Volts/div. | Measured Channel 1 Impedance Ω, MΩ | Measured Channel 2 Impedance Ω, MΩ | Measured Channel 3 Impedance Ω, MΩ | Measured Channel 4 Impedance Ω, MΩ | Measured External Impedance Ω, MΩ | 104/204Xi Limits Lower Limit Ω, MΩ | 104/204Xi Limits Upper Limit Ω, MΩ | Lower Limit Ω, MΩ | Upper Limit Ω, MΩ |
|---|---|---|---|---|---|---|---|---|---|---|
| DC 50Ω | 20 mV/div | | | | | | 49.5 Ω | 50.5 Ω | 49.25 Ω | 50.75 Ω |
| DC 50Ω | 200 mV/div | | | | | | 49.5 Ω | 50.5 Ω | 49.25 Ω | 50.75 Ω |
| DC 1MΩ | 20 mV/div | | | | | | 0.990 MΩ | 1.010 MΩ | 0.9875 MΩ | 1.0125 MΩ |
| DC 1MΩ | 200 mV/div | | | | | | 0.990 MΩ | 1.010 MΩ | 0.9875 MΩ | 1.0125 MΩ |
| DC 1MΩ | 2 V/div | | | | | | 0.990 MΩ | 1.010 MΩ | 0.9875 MΩ | 1.0125 MΩ |
| DC 50Ω | | | | | | | 49.5 Ω | 50.5 Ω | 49.25 Ω | 50.75 Ω |
| DC 1MΩ | | | | | | | 0.990 MΩ | 1.010 MΩ | 0.9875 MΩ | 1.0125 MΩ |

**Table 2: Impedance Test Record**

| Coupling | Volts/div. | Measured Channel 1 Leakage mV | Measured Channel 2 Leakage mV | Measured Channel 3 Leakage mV | Measured Channel 4 Leakage mV | Measured External Leakage mV | Lower Limit mV | Upper Limit mV |
|---|---|---|---|---|---|---|---|---|
| DC 50Ω | 20 mV/div | | | | | | –2 | +2 |
| DC 50Ω | 200 mV/div | | | | | | -2 | +2 |
| DC 1MΩ | 20 mV/div | | | | | | –2 | +2 |
| DC 1MΩ | 200 mV/div | | | | | | –2 | +2 |
| DC 1MΩ | 2V/div | | | | | | –2 | +2 |
| AC 1MΩ | 20 mV/div | | | | | | –2 | +2 |
| DC 50Ω | | | | | | | –2 | +2 |
| DC 1MΩ | | | | | | | –2 | +2 |

**Table 3: Leakage Voltage Test Record**

| V/Div | Measured SDEV Channel 1 mV | Measured SDEV Channel 2 mV | Measured SDEV Channel 3 mV | Measured SDEV Channel 4 mV | Limits SDEV mV |
|---|---|---|---|---|---|
| 2 mV | | | | | 0.23 |
| 5 mV | | | | | 0.32 |
| 10 mV | | | | | 0.45 |
| 20 mV | | | | | 0.90 |
| 50 mV | | | | | 2.24 |
| 100 mV | | | | | 4.45 |
| 200 mV | | | | | 9.0 |
| 500 mV | | | | | 22.4 |
| 1V | | | | | 45 |

**Table 4: 50 Ohm Sdev Noise Test Record**

| V/Div | Measured SDEV Channel 1 mV | Measured SDEV Channel 2 mV | Measured SDEV Channel 3 mV | Measured SDEV Channel 4 mV | Limits SDEV mV 50 Ohm | Limits SDEV mV 1 Mohm |
|---|---|---|---|---|---|---|
| 2 mV | | | | | 0.337 | 0.357 |
| 5 mV | | | | | 0.532 | 0.563 |
| 10 mV | | | | | 0.753 | 0.753 |
| 20 mV | | | | | 1.07 | 1.07 |
| 100 mV | | | | | 7.53 | 7.53 |
| 200 mV | | | | | 10.65 | 10.65 |
| 2V | | | | | | 106.54 |

**Table 5: Sdev Noise Test Record (WR104/204Xi only)**

| Volts /div. | Attenuator | P S Output | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | mV |
| 2 mV | X 100 | +0.6 V | | | | | | | | | | | | | ±1.37 |
| 5 mV | X 100 | +1.5 V | | | | | | | | | | | | | ±1.85 |
| 10 mV | X 10 | +0.3 V | | | | | | | | | | | | | ±2.25 |
| 50 mV | X 10 | +1.5V | | | | | | | | | | | | | ±7.5 |
| 100mV | X 1 | +0.3 V | | | | | | | | | | | | | ±13.5 |
| 200mV | X 1 | +0.6 V | | | | | | | | | | | | | ±26 |
| 1v | X 1 | +3.0 V | | | | | | | | | | | | | ±126 |

Table 6: DC 50Ω, Positive DC Accuracy Test Record

| Volts /div. | Attenuator | P S Output | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | mV |
| 2 mV | X 100 | -0.6 V | | | | | | | | | | | | | ±1.37 |
| 5 mV | X 100 | -1.5 V | | | | | | | | | | | | | ±1.85 |
| 10 mV | X 10 | -0.3 V | | | | | | | | | | | | | ±2.25 |
| 50mV | X 10 | -1.5V | | | | | | | | | | | | | ±7.5 |
| 100mV | X 1 | -0.3 V | | | | | | | | | | | | | ±13.5 |
| 200mV | X 1 | -0.6 V | | | | | | | | | | | | | ±26 |
| 1V | X 1 | -3.0 V | | | | | | | | | | | | | ±126 |

Table 7: DC 50Ω, Negative DC Accuracy Test Record

| Volts /div. | Attenuator | P S Output | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | mV |
| 2 mV | X 100 | +0.6 V | | | | | | | | | | | | | ±1.37 |
| 5 mV | X 100 | +1.5 V | | | | | | | | | | | | | ±1.85 |
| 10 mV | X 10 | +0.3 V | | | | | | | | | | | | | ±2.25 |
| 50mV | X 10 | +1.5V | | | | | | | | | | | | | ±7.5 |
| 100mV | X 1 | +0.3 V | | | | | | | | | | | | | ±13.5 |
| 200 mV | X 1 | +0.6 V | | | | | | | | | | | | | ±26 |
| 1 V | X 1 | +3.0 V | | | | | | | | | | | | | ±126 |

**Table 8: DC 1MΩ, Positive DC Accuracy Test Record**

| Volts /div. | Attenuator | P S Output | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | mV |
| 2 mV | X 100 | -0.6 V | | | | | | | | | | | | | ±1.37 |
| 5 mV | X 100 | -1.5 V | | | | | | | | | | | | | ±1.85 |
| 10 mV | X 10 | -0.3 V | | | | | | | | | | | | | ±2.25 |
| 50mV | X 10 | -1.5V | | | | | | | | | | | | | ±7.5 |
| 100mV | X 1 | -0.3 V | | | | | | | | | | | | | ±13.5 |
| 200mV | X 1 | -0.6 V | | | | | | | | | | | | | ±26 |
| 1v | X 1 | -3.0 V | | | | | | | | | | | | | ±126 |

**Table 9: DC 1MΩ, Negative DC Accuracy Test Record**

| Volt /div. | Coupling DC | DSO Offset V | P S Output V | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits mV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | Note1 ±14.2 Note2 ±16.2 |
| 50mV | 50 Ω | +.750 | –.750 | | | | | | | | | | | | | |

**Table 10: Positive 50Ω Offset Test Record**

| Volt /div. | Coupling DC | DSO Offset V | P S Output V | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | Note1 ±14.2 Note2 ±16.2 |
| 50mV | 50 Ω | -.750 | +.750 | | | | | | | | | | | | | |

**Table 11: Negative 50Ω Offset Test Record**

| Volt /div. | Coupling DC | DSO Offset V | P S Output V | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | Note1 ±14.2 Note2 ±16.2 |
| 50mV | 1 MΩ | +.750 | –.750 | | | | | | | | | | | | | |

**Table 12: Positive 1MΩ Offset Test Record**

*NOTE 1: Offset limit for the model 44/62 and 64Xi is +/-14.2mV
*NOTE 2: Offset limit for the model 104/204Xi is +/-16.2mV

| Volt /div. | Coupling DC | DSO Offset V | P S Output V | Measured Channel 1 V & mV | | | Measured Channel 2 V & mV | | | Measured Channel 3 V & mV | | | Measured Channel 4 V & mV | | | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DMM 1 | Mean (A) | Δ 1 Mean–DMM | DMM 2 | Mean (B) | Δ 2 Mean–DMM | DMM 3 | Mean (C) | Δ 3 Mean–DMM | DMM 4 | Mean (D) | Δ 4 Mean–DMM | Note1 ±14.2 Note2 |
| 50mV | 1 MΩ | -.750 | +.750 | | | | | | | | | | | | | ±16.2 |

**Table 13: Negative 1MΩ Offset Test Record**

| Frequency | Measured Power | Generator Amplitude | Measured Channel 1 | | Measured Channel 2 | | Measured Channel 3 | | Measured Channel 4 | | Lower Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | µW | mV | sdev(1) mV | Ratio(1) to 10 | sdev (2) mV | Ratio(2) to 10 | sdev (3) mV | Ratio(3) to 10 | sdev (4) mV | Ratio(4) to 10 | |
| 10 | 8.0 | | | N/A | | N/A | | N/A | | N/A | N/A |
| 400.1 (WR 44Xi) | 8.0 | | | | | | | | | | 0.707 |
| 600.1 (WR 64Xi) | 8.0 | | | | | | | | | | 0.707 |
| 600.1 (WR 62Xi) | 8.0 | | | | | | N/A | N/A | N/A | N/A | 0.707 |
| 1000.1 (WR 104Xi) | 8.0 | | | | | | | | | | 0.707 |
| 2000.1 (WR 204Xi) | 8.0 | | | | | | | | | | 0.707 |

**Table 14: DC 50Ω, 10 mV/div. Bandwidth Test Record**

| Frequency | Measured Power | Generator Amplitude | Measured Channel 1 | | Measured Channel 2 | | Measured Channel 3 | | Measured Channel 4 | | Lower Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | mW | mV | sdev(1) mV | Ratio(1) to 10 | sdev (2) mV | Ratio(2) to 10 | sdev (3) mV | Ratio(3) to 10 | sdev (4) mV | Ratio(4) to 10 | |
| 10 | 0.22 | | | N/A | | N/A | | N/A | | N/A | N/A |
| 400.1 (WR 44Xi) | 0.22 | | | | | | | | | | 0.707 |
| 600.1 (WR 64Xi) | 0.22 | | | | | | | | | | 0.707 |
| 600.1 (WR 62Xi) | 0.22 | | | | | | N/A | N/A | N/A | N/A | 0.707 |
| 1000.1 (WR 104Xi) | 0.22 | | | | | | | | | | 0.707 |
| 2000.1 (WR 204Xi) | 0.22 | | | | | | | | | | 0.707 |

**Table 15: DC 50Ω, 50 mV/div. Bandwidth Test Record**

| Frequency | Measured Power | Generator Amplitude | Measured Channel 1 | | Measured Channel 2 | | Measured Channel 3 | | Measured Channel 4 | | Lower Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | mW | mV | sdev(1) mV | Ratio(1) to 10 | sdev (2) mV | Ratio(2) to 10 | sdev (3) mV | Ratio(3) to 10 | sdev (4) mV | Ratio(4) to 10 | |
| 10 | 0.8 | | | N/A | | N/A | | N/A | | N/A | N/A |
| 400.1 (WR 44Xi) | 0.8 | | | | | | | | | | 0.707 |
| 600.1 (WR 64Xi) | 0.8 | | | | | | | | | | 0.707 |
| 600.1 (WR 62Xi) | 0.8 | | | | | | N/A | N/A | N/A | N/A | 0.707 |
| 1000.1 (WR 104Xi) | 0.8 | | | | | | | | | | 0.707 |
| 2000.1 (WR 204Xi) | 0.8 | | | | | | | | | | 0.707 |

**Table 16: DC 50Ω, 100 mV/div. Bandwidth Test Record**

| Frequency | Measured Power | Generator Amplitude | Measured Channel 1 | | Measured Channel 2 | | Measured Channel 3 | | Measured Channel 4 | | Lower Limit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | mW | mV | sdev(1) mV | Ratio(1) to 10 | sdev (2) mV | Ratio(2) to 10 | sdev (3) mV | Ratio(3) to 10 | sdev (4) mV | Ratio(4) to 10 | |
| 10 | 22.0 | | | N/A | | N/A | | N/A | | N/A | N/A |
| 400.1 (WR 44Xi) | 22.0 | | | | | | | | | | 0.707 |
| 600.1 (WR 64Xi) | 22.0 | | | | | | | | | | 0.707 |
| 600.1 (WR 62Xi) | 22.0 | | | | | | N/A | N/A | N/A | N/A | 0.707 |
| 1000.1 (WR 104Xi) | 22.0 | | | | | | | | | | 0.707 |
| 2000.1 (WR 204Xi) | 22.0 | | | | | | | | | | 0.707 |

**Table 17: DC 50Ω, 500mV/div. Bandwidth Test Record**

| Trigger Level | Trigger Slope | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Lower Limit | Upper Limit |
|---|---|---|---|---|---|---|---|
| mV | | Measured DC Trigger Level (1) mV | Measured DC Trigger Level (2) mV | Measured DC Trigger Level (3) mV | Measured DC Trigger Level (4) mV | mV | mV |
| 0 | Pos | | | | | –34 | +34 |
| 0 | Neg | | | | | –34 | +34 |
| +250 | Pos | | | | | +216 | +284 |
| +250 | Neg | | | | | +216 | +284 |
| –250 | Pos | | | | | -284 | -216 |
| –250 | Neg | | | | | -284 | -216 |

**Table 18: Channel DC Trigger Test Record**

| Generator Frequency MHz | Freq.(1) (Hz) | Lower Limit | Upper Limit |
|---|---|---|---|
| 10.0 | | -100 | +100 |

**Table 19: Time Base Test Record**

# 5. Performance Verification

## 5.1 Introduction

This chapter contains procedures suitable for determining if the WaveRunnner Xi Series of Digital Storage Oscilloscope performs correctly and as warranted. They check all the characteristics listed in subsection 5.1.1.

In the absence of the computer automated calibration system based on LeCroy Calibration Software (Calsoft), this manual performance verification procedure can be followed to establish a traceable calibration. It is the calibrating entities' responsibility to ensure that all laboratory standards used to perform this procedure are operating within their specifications and traceable to required standards if a traceable calibration certificate is to be issued for the WaveRunnner Xi Digital Storage Oscilloscope.

### 5.1.1 List of Tested Characteristics

This subsection lists the characteristics that are tested in terms of quantifiable performance limits.

- Input Impedance
- Leakage Current
- Sdev noise level
- Positive and Negative DC accuracy
- Positive and Negative Offset
- Bandwidth
- Trigger Accuracy
- Time Base Accuracy

### 5.1.2 Calibration Cycle

The WaveRunnnerXi Digital Storage Oscilloscope requires periodic verification of performance. Under normal use (2,000 hours of use per year) and environmental conditions, this instruments calibration cycle is 12 months.

## 5.2 Test Equipment Required

These procedures use external, traceable signal generators, DC precision power supply and digital multi-meter, to directly check specifications. If a low noise precision DC calibrator is used no attenuators are needed.

| Instrument | Specifications | Recommended |
|---|---|---|
| Signal Generator Radio Frequency | Frequency : .5 MHz to 2 GHz<br>Frequency Accuracy : 1 PPM | HP 8648B/C, Fluke 9500 or equivalent |
| Signal Generator Audio Frequency | Frequency : 0 to 500 kHz<br>Amplitude : 8 V peak to peak | HP33120A, Fluke9500 or equivalent |
| Voltage Generator DC Power Supply | Range of 0 to 20 V, in steps of no more than 15 mV | HP 6633A, Fluke9500 or equivalent |
| Power Meter + Sensor | Accuracy ±1 % | HP437B + 8482A or equivalent |
| Digital Multimeter Volt & Ohm | Voltmeter Accuracy : 0.1 %<br>Ohmmeter Accuracy : 0.1 % | Keithley 2000, or equivalent |
| 2 Coaxial Cable | 50Ω, BNC, length 100 cm | |
| 1 Coaxial Cable | 50Ω, SMA, length 100 cm | |
| Adapter | 50Ω, SMA to BNC | |
| 2 Attenuators | 50Ω, BNC, 1 % accuracy | |
| T adapter | 50Ω, BNC T adapter | |
| Terminator | 50Ω, BNC 1 % accuracy | |

**Table 5-1 : Test Equipment**

### 5.2.1 Test Records

The last pages of this document contain WaveRunnnerXi test records in the format tables. Keep them as masters and use a photocopy for each calibration.

## 5.3 Turn On

If you are not familiar with operating the WaveRunnnerXi, refer to the operator's manual and getting started guide.

- Switch on the power using the power switch.
- Wait for about 20 minutes for the scope to reach a stable operating temperature.

- Insert a removable USB device with panel setups (e.g. Memory stick, CD ROM drive).

## 5.4 Input Impedance

| WR6x/44Xi Specifications | WR104Xi/204Xi Specifications |
|---|---|
| DC 50Ω ±1.0 % | DC 50Ω ±1.5 % |
| EXT DC 50Ω ±1.0 % | EXT DC 50Ω ±1.5 % |
| DC 1MΩ ±1.0% | DC 1MΩ ±1.25% |

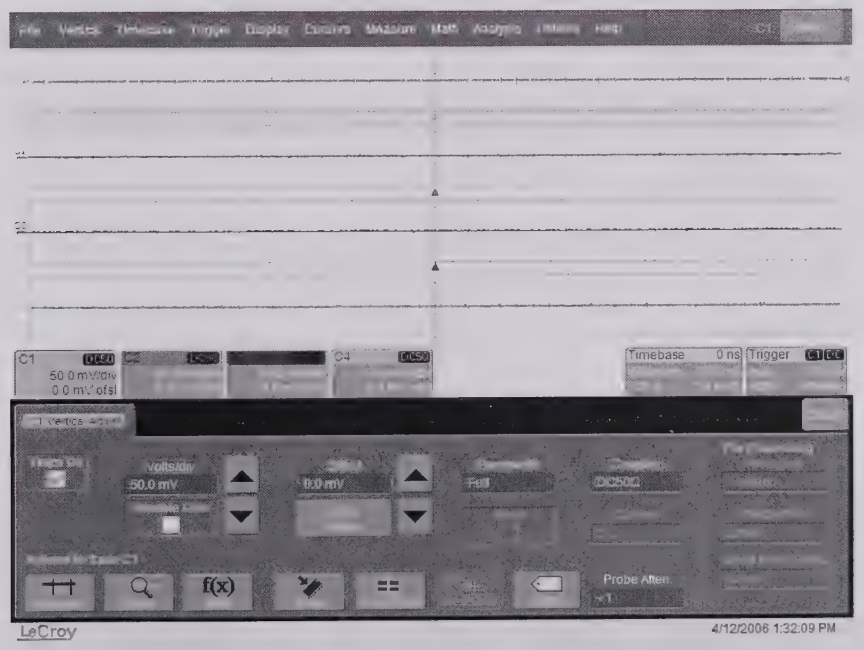
The impedance values for 50Ω and 1MΩ coupling are measured with a high precision digital multimeter. The DMM is connected to the DSO in 4 wire configuration (input and sense), allowing for accurate measurements. ***Check that the DMM used is measuring the 1 MΩ inputs in at least a 3 MΩ range. If tested in a lower range some readings may not be within specifications***.

### 5.4.1 Channel Input Impedance

#### a. DC 50Ω

- Recall **Input Impedance - 50 ohm x1.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 50Ω** on all 4 Channels |
| Input gain | : | **20 mV/div.** on all 4 Channels |
| Time base | : | **50 ηsec/div.** |
| Trigger mode | : | **Auto** |

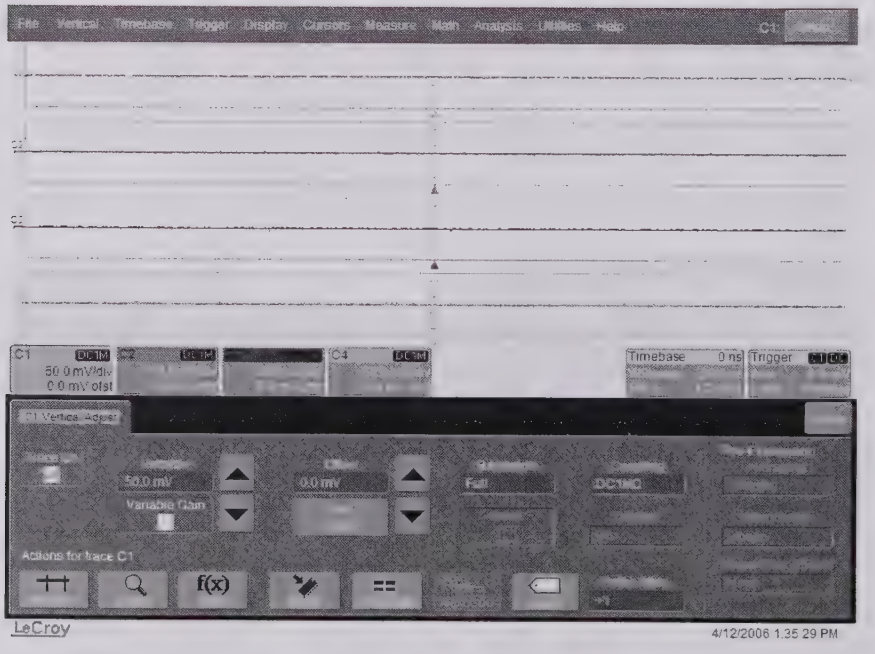


- Set the DMM with **Ohms and Ohms sense** to provide a 4 wire measurement.
- Connect the DMM to Channel 1.
- Measure the **input impedance**, reverse the meter leads and measure the input impedance.
- **Average** these two numbers and record it in Table 2, and compare it to the limits.
- Repeat the above test for all input channels.
- Recall **Input Impedance - 50 ohm x10.lss** or set input gain to **200 mV/div.** on all 4 Channels.
- Repeat the test for all input channels.
- **Record** the measurements in Table 2, and **compare** the test results to the limits in the test record.

### b. DC 1MΩ

- Recall **Input Impedance - 1 Mohm x1.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 1 MΩ** on all 4 Channels |
| Input gain | : | **20 mV/div.** on all 4 Channels |
| Time base | : | **50 ηsec/div.** |
| Trigger mode | : | **Auto** |



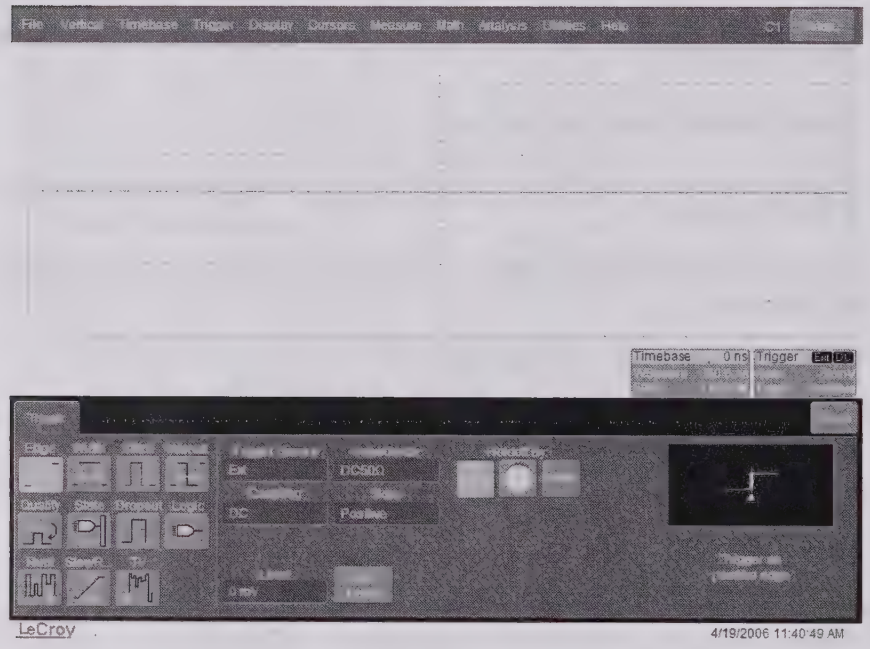
- Set the DMM with **Ohms and Ohms sense** to provide a 4 wire measurement.
- Connect the DMM to Channel 1.
- Measure the **input impedance**, reverse the meter leads and measure the input impedance.
- **Average** these two numbers and **record** it in Table 2, and compare it to the limits.
- Repeat the above test for all input channels.
- Recall **Input Impedance - 1 Mohm x10.lss** or Set Input gain to **200 mV/div.** on all 4 Channels.
- Repeat the test for all input channels.
- **Record** the measurements in Table 2, and compare the test results to the limits in the test record.
- Recall **Input Impedance - 1 Mohm x100.lsss** or Set Input gain to **2 V/div.** on all 4 Channels.
- Repeat the test for all input channels.
- **Record** the measurements in Table 2, and compare the test results to the limits in the test record.

### 5.4.2 External Trigger Input Impedance

#### a. DC 50Ω

- Recall **Input Impedance - 50 ohm ext x1.lss** or configure the DSO:

  Select Setup trigger
  Trigger on : **EXT**
  Impedance : **DC 50Ω**




- Connect the DMM to External, and measure the **input impedance**, reverse the meter leads and measure the input impedance.

- **Average** these two numbers and **record** the input impedance in Table 2. **Compare** the result to the limit in the test record.

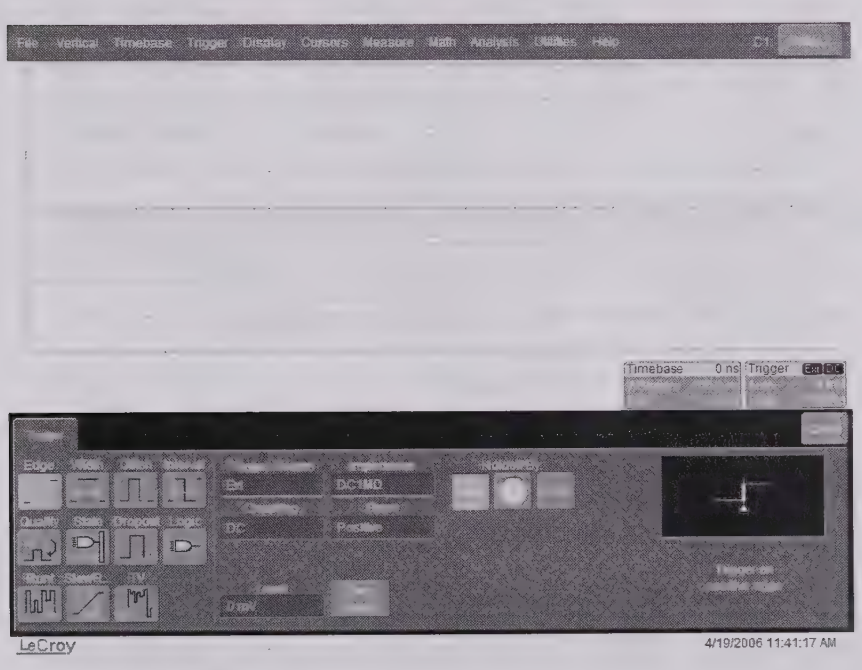
### b. Ext DC 1MΩ Input Impedance

- Recall **Input Impedance - 1 Mohm DC Ext x1.lss** or configure the DSO:

  Select Setup trigger

  Trigger on : **EXT**

  Impedance : **DC 1MΩ**




- Connect the DMM to External, and measure the **input impedance**, reverse the meter leads and measure the input impedance.
- **Average** these two numbers and record the input impedance in Table 2, and compare the result to the limit in the test record.

## 5.5 Leakage Current

### Specifications

DC 50Ω, EXT DC 50Ω : ±2 mV
DC/AC 1M, ±2 mV

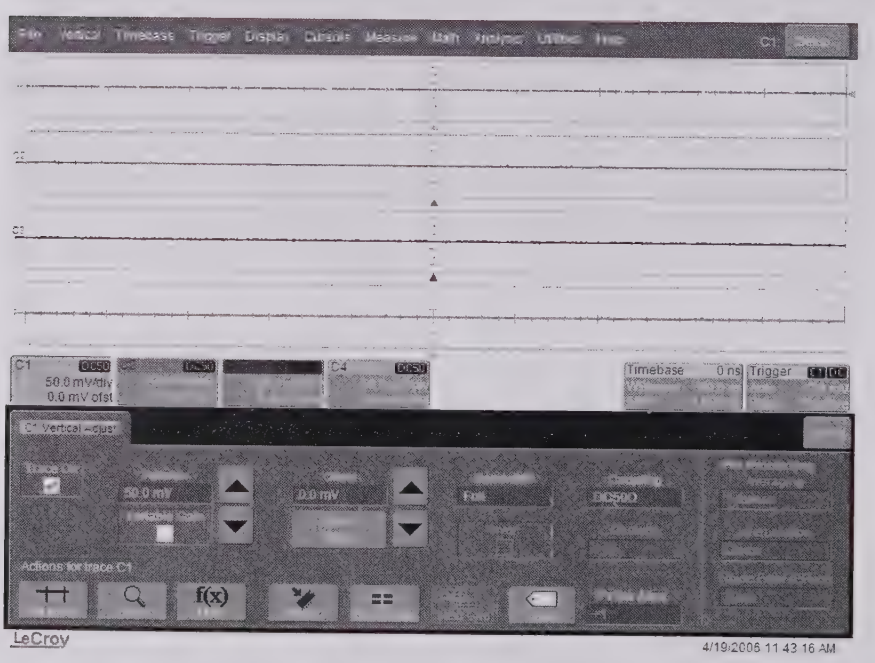
The leakage current is tested by measuring the voltage across the input channel.

### 5.5.1 Channel Leakage Current

#### a. DC 50Ω

- Recall **Leakage - 50 ohm x1.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 50Ω** on all 4 Channels |
| Input gain | : | **20 mV/div.** on all 4 Channels |
| Trigger mode | : | **Auto** |
| Time base | : | **50 ηsec/div.** |



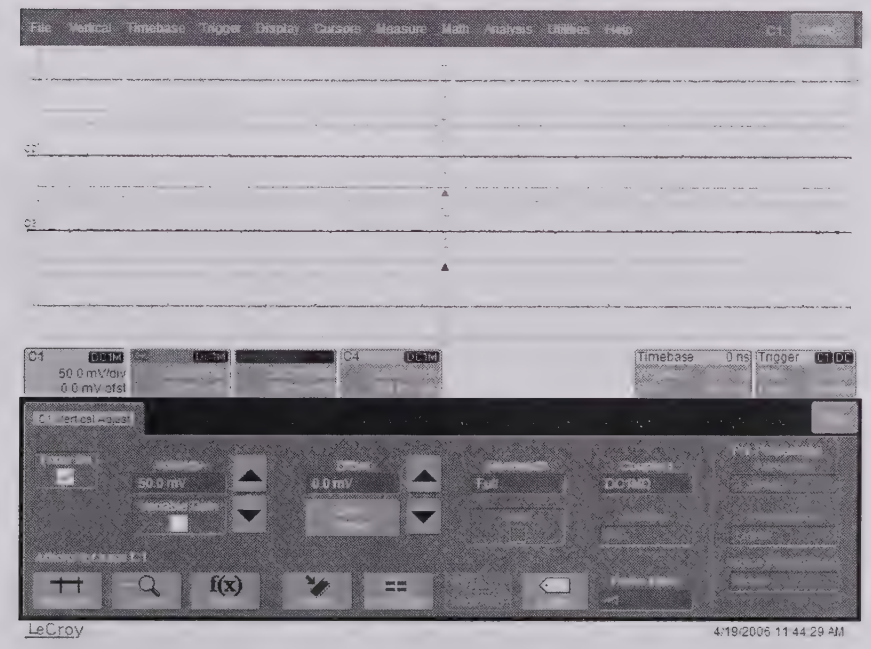

- Set the DMM to measure Volts, and connect it to Channel 1.
- Measure the **voltage** and enter it in Table 3. Compare it to the limits.
- Repeat the test for all input channels.

- Recall **Leakage - 50 ohm x10.lss** or set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, compare the results to the limits in the test record.

**b. DC 1MΩ**

- Recall **Leakage - 1 Mohm x1.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 1MΩ** on all 4 Channels |
| Input gain | : | **20 mV/div.** on all 4 Channels |
| Trigger mode | : | **Auto** |
| Time base | : | **50 ηsec/div.** |



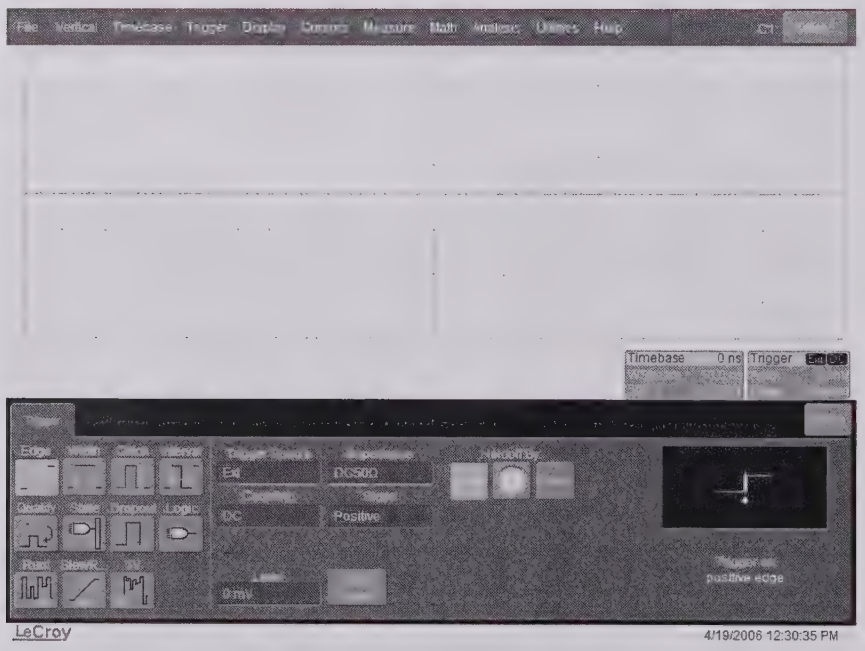

- Set the DMM to measure Volts, and connect it to Channel 1.
- Measure the **voltage** and enter it in Table 3. Compare the result to the limits in the test record.
- Repeat the test for all input channels.
- Recall **Leakage - 1 Mohm x10.lss** or set Input gain to **200 mV/div.** on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.

- Recall **Leakage - 1 Mohm x100.lss** or set Input gain to 2 V/div. on all 4 Channels
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.
- Recall **Leakage - 1 Mohm AC x1.lss** or set Input gain to **20 mV/div.** on all 4 Channels.
- Repeat the test for all input channels. Record the measurements in Table 3, and compare the results to the limits in the test record.

### 5.5.2 External Trigger Leakage Current

**a. DC 50Ω**

- Recall **Leakage - 50 ohm ext x1.lss** or configure the DSO as shown in 5.5.1 and make the following changes:
  Select Setup trigger
  Set Trigger on : **EXT**
  Impedance : **DC 50Ω**



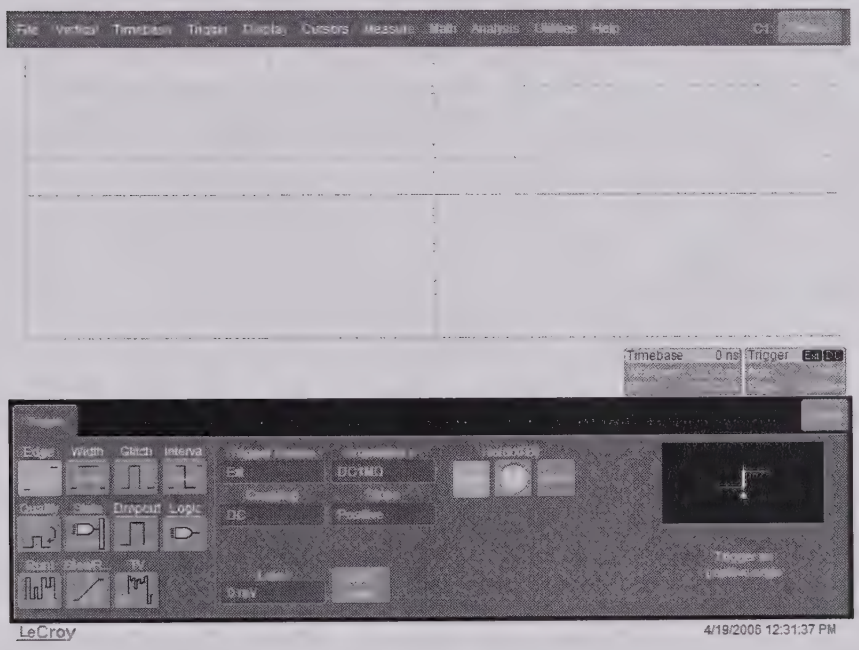

- Connect the DMM to External.
- Measure the voltage and enter it in Table 3. Compare the results to the limits in the test record

**b. DC 1MΩ**

- Recall **Leakage - 1 Mohm ext x1.lss** or configure the DSO as shown in 5.5.1 and make the following changes:

  Select Setup trigger
  Set Trigger on : **EXT**

  Impedance : **DC 1MΩ**




- Connect the DMM to External.
- Measure the voltage and enter it in Table 3. Compare it to the limits.

## 5.6 Noise Level

### Description

Noise tests with open inputs are executed on all channels with 0 mV offset, at a gain setting listed in the test record. The scope parameters functions are used to measure the Sdev of the noise.

**WR6x, 44Xi Specifications**

Signal to Noise ratio:
>28db @ 2mV
>33db @ 5mV
>36db @ ≥10mV

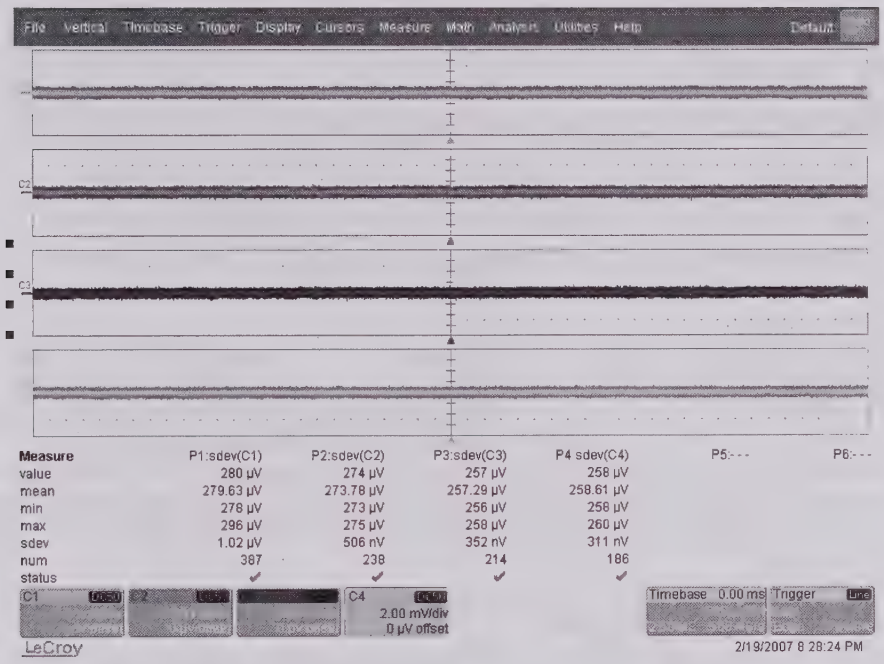
**WR104/204Xi Specifications**

Signal to Noise ratio:
>24db @ 2mV
>28db @ 5mV
>31.5db @ 10mV and 100mV
>34.5db @ 20mV, 200Mv and 2V

With no signal connected to the inputs

- Recall **Noise sdev - 2mv.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 50Ω** on all 4 Channels |
| Input gain | : | **2 mV/div.** on all 4 Channels |
| Input offset | : | **0.0 mV** on all 4 Channels |
| Trigger setup | : | **Edge** |
| Trigger on | : | **C1** |
| Trigger Mode | : | **Auto** |
| Time base | : | **500 µsec/div.** |
| Max sample points: | | **2.5MS** |
| Active Channels | : | **4 (2 for 2 channel scope)** |
| Sampling mode | : | **Real Time** |
| Press | : | **Measure, Measure Setup,** |
| Statistics | : | **On** |
| Add parameters | | |
| P1 | : | **Measure sdev of Ch1** |
| P2 | : | **Measure sdev of Ch2** |
| P3 | : | **Measure sdev of Ch3** |
| P4 | : | **Measure sdev of Ch4** |


File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help Default
Measure P1:sdev(C1) P2:sdev(C2) P3:sdev(C3) P4 sdev(C4) P5:- - - P6:- - -
value 280 µV 274 µV 257 µV 258 µV
mean 279.63 µV 273.78 µV 257.29 µV 258.61 µV
min 278 µV 273 µV 256 µV 258 µV
max 296 µV 275 µV 258 µV 260 µV
sdev 1.02 µV 506 nV 352 nV 311 nV
num 387 238 214 186
status
C1
C4
2.00 mV/div
0 µV offset
Timebase 0.00 ns
Trigger
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- Press **Clear Sweeps.**

Measure for at least **20 sweeps**, and then press **Stop** to halt the acquisition.

- Record the four **mean sdev** parameter values in Table 4, and compare the test results to the limits in the test record.

- Repeat for all ranges listed in the test record.

- **The WR104/204Xi tests the 1Mohm inputs also. Recall Noise sdev 1Mohm - 2mv.lss (or configure the DSO manually) when testing this input coupling. Record the results in Table 5.**

## 5.7 DC Accuracy

**Specification: In all cases the offset is 0mV.**

**2mV/div = ≤ ±3.5 % of reading + 1.0% of FS + 1mV full scale**

**5mV/div = ≤ ±3.0 % of reading + 1.0% of FS + 1mV full scale**

**10mV/div = ≤ ±1.5 % of reading + 1.0% of FS + 1mV full scale**

### Description

This test measures the absolute voltage DC Accuracy within the gain range specified.
It requires a DC source with a voltage range of 0 V to 6 V adjustable in steps of no more than 15 mV and a calibrated DMM that can measure voltage to 0.1 %.
Measurements are made using voltage values applied by the external voltage reference source, measured by the DMM, and in the oscilloscope using the parameter Mean. For each known input voltage, the deviation is checked against the tolerance.

### 5.7.1 Positive 50Ω DC Accuracy

### Procedure

- Recall **DC accuracy - 50 ohm 2mv.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 50Ω** on all 4 Channels |
| Input offset | : | **0.0 mV** on all 4 Channels |
| Input gain | : | **2mV/div to 1 V/div.** (see Table 6) on all 4 Ch |
| BW limit | : | **200 MHz** |
| C1 Averaging | : | **1 sweeps** |
| C2 Averaging | : | **1 sweeps** |
| C3 Averaging | : | **1 sweeps** |
| C4 Averaging | : | **1 sweeps** |
| Trigger setup | : | **Edge** |
| Trigger on | : | **Line** |
| Mode | : | **Auto** |
| Time base | : | **1 µsec/div**. |
| Active Channels | : | **4 (2 for 2 channel scope)** |
| Sampling mode | : | **Real Time** |
| Change parameters | | |
| P1 | : | **Measure mean of C1** |
| P2 | : | **Measure mean of C2** |
| P3 | : | **Measure mean of C3** |
| P4 | : | **Measure mean of C4** |

The following test setups are a suggested setup which will work with power supplies which do not have enough resolution in their set points or are noisy at low voltages. If you are using a precision DC calibrator you need not use 20db attenuators as shown in Fig 5-1 or 5-2 and can use the setup of figure 5-3.

- For the low sensitivities: **2 mV** and **5 mV/div** connect the test equipment as shown in Figure 5-1.

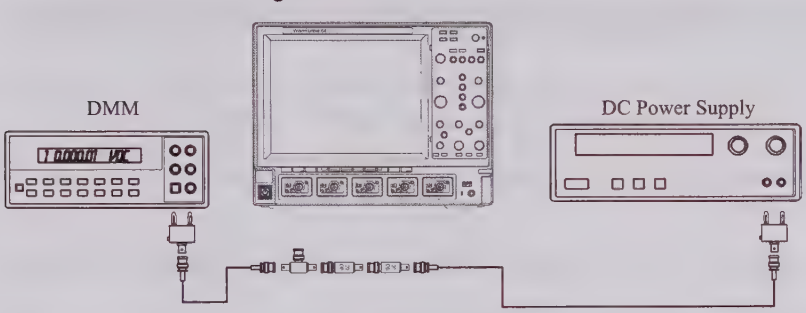



**Figure 5-1 : DC 50Ω Accuracy Equipment Setup for 2 mV and 5 mV/div**

- For the sensitivities: **10 mV** and **50 mV/div** connect the test equipment as shown in Figure 5-2.

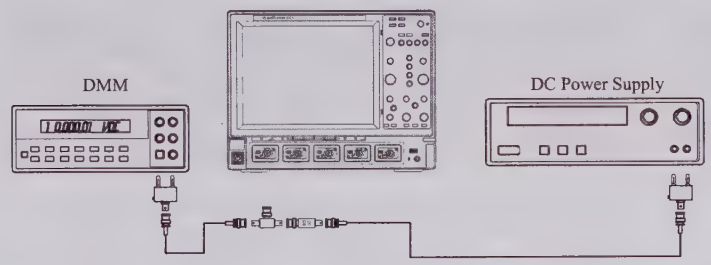



**Figure 5-2 : DC 50Ω Accuracy Equipment Setup for 10 mV and 50 mV/div**

- For the range **100mV** to **1 V/div** no attenuator is required, connect the test equipment as shown in Figure 5-3.

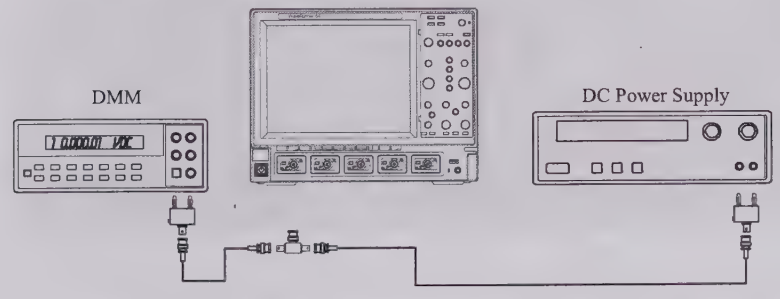



**Figure 5-3 : DC 50Ω Accuracy Equipment Setup for 100 mV to 1 V/div.**

▪ For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 6, column **PS output**.

1) Connect the DMM and record the **voltage reading** in Table 6, column **DMM.**

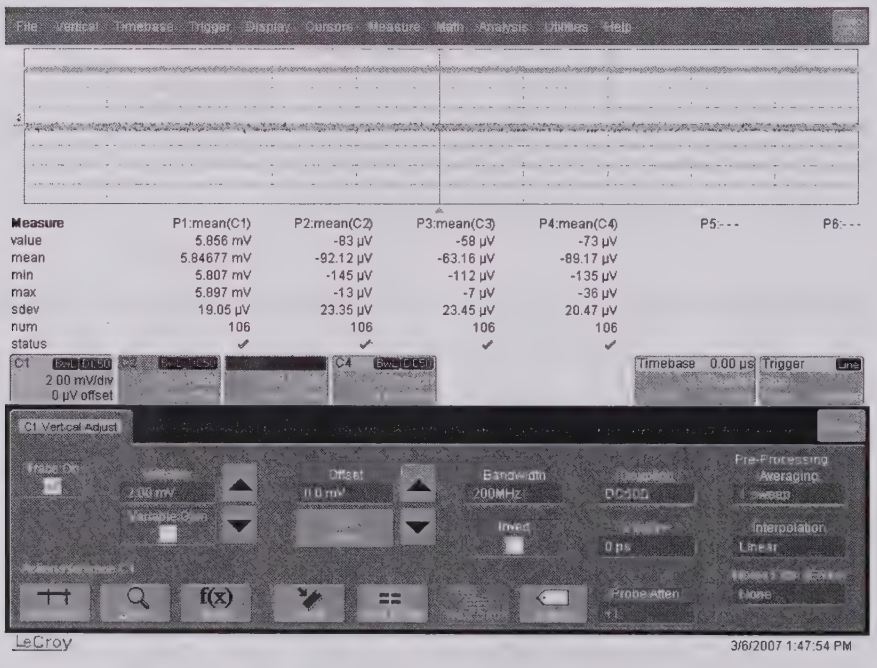
2) Press **Clear Sweeps**

3) After 100 sweeps **PRESS STOP**. Read off the **DSO mean parameter** and record the measurement in Table 6, column **Mean**.

4) Moving the DC input repeat step 2 and 3 for each channel setting the trigger to Auto.

- For each DC voltage applied to the DSO input, repeat parts 1, 2, 3 and 4.

- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 6 and compare the **Difference ( Δ )** to the corresponding limit in the test record.


File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
Measure P1:mean(C1) P2:mean(C2) P3:mean(C3) P4:mean(C4) P5:--- P6:---
value 5.856 mV -83 µV -58 µV -73 µV
mean 5.84677 mV -92.12 µV -63.16 µV -89.17 µV
min 5.807 mV -145 µV -112 µV -135 µV
max 5.897 mV -13 µV -7 µV -36 µV
sdev 19.05 µV 23.35 µV 23.45 µV 20.47 µV
num 106 106 106 106
status
C1 2.00 mV/div 0 µV offset
C1 Vertical Adjust
Offset
Bandwidth
200MHz
Pre-Processing
Averaging
Sweep
Interpolation
Linear
Probe Atten
None
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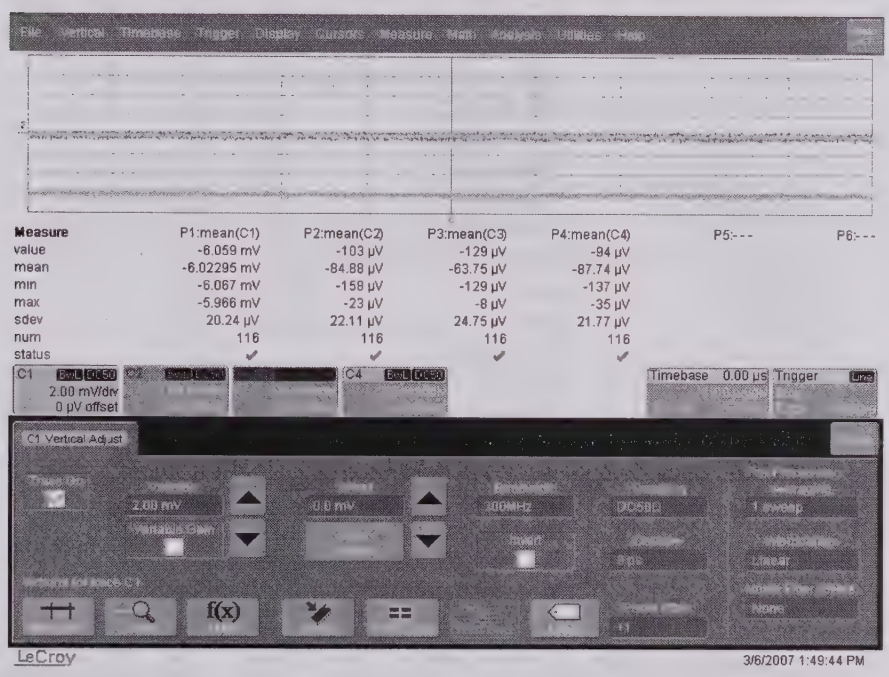
### 5.7.2 Negative 50Ω DC Accuracy

- Recall **DC accuracy - 50 ohm 2mv.lss** or configure the DSO as shown in 5.7.1.
- Connect the test equipment as shown in either Figure 5-1 or 5-2 or 5-3.
- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 7, column PS output. (if a banana-BNC adapter is being used it can simply be turned to get the opposite polarity)




1) Connect the DMM and record the **voltage reading** in Table 7, column **DMM.**

2) Press **Clear Sweeps**

3) After 100 sweeps **PRESS STOP**. Read off the **DSO mean parameter** and record the measurement in Table 7, column **Mean**.

4) Moving the DC input, repeat step 2 and 3 for each channel setting the trigger to Auto

- For each DC voltage applied to the DSO input, repeat parts 1, 2, 3 and 4.
- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 7 and compare the **Difference ( Δ )** to the corresponding limit in the test record.

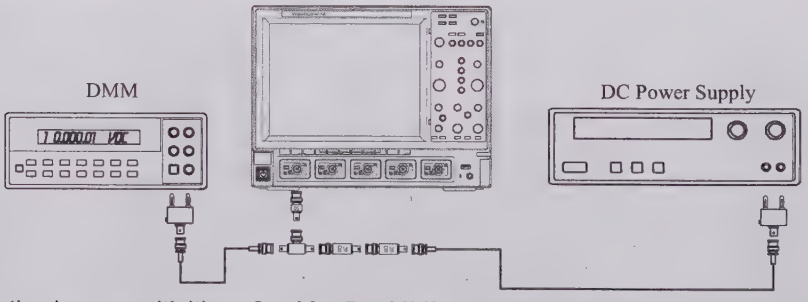
### 5.7.1 Positive 1MΩ DC Accuracy

## Procedure

- Recall **DC accuracy - 1 Mohm 2mv.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 1MΩ** on all 4 Channels |
| Input offset | : | **0.0 mV** on all 4 Channels |
| Input gain | : | **2mV/div to 1 V/div.** (see Table 8) on all 4 Ch |
| BW Limit | : | **200 MHz** |
| C1 Averaging | : | **1 sweeps** |
| C2 Averaging | : | **1 sweeps** |
| C3 Averaging | : | **1 sweeps** |
| C4 Averaging | : | **1 sweeps** |
| Trigger setup | : | **Edge** |
| Trigger on | : | **Line** |
| Mode | : | **Auto** |
| Time base | : | **1 µsec/div.** |
| Active Channels | : | **4 (2 for 2 channel scope)** |
| Sampling mode | : | **Real Time** |
| Change parameters | | |
| P1 | : | **Measure mean of C1** |
| P2 | : | **Measure mean of C2** |
| P3 | : | **Measure mean of C3** |
| P4 | : | **Measure mean of C4** |

The following test setups are a suggested setup which will work with power supplies which do not have enough resolution in their set points or are noisy at low voltages. If you are using a precision DC calibrator you need not use 20db attenuators as shown in Fig 5-4 or 5-5 and can use the setup of figure 5-6.




For the low sensitivities: **2 mV - 5 mV/div** connect the test equipment as shown in Figure 5-4. Also connect a 50 ohm terminator at scope input.

**Figure 5-4 : DC 1MΩ Accuracy Equipment Setup for 2 mV and 5 mV/div**

- For the sensitivities: **10 mV** and **50 mV/div**, connect the test equipment as shown in Figure 5-5. Also connect a 50 ohm terminator at scope input.

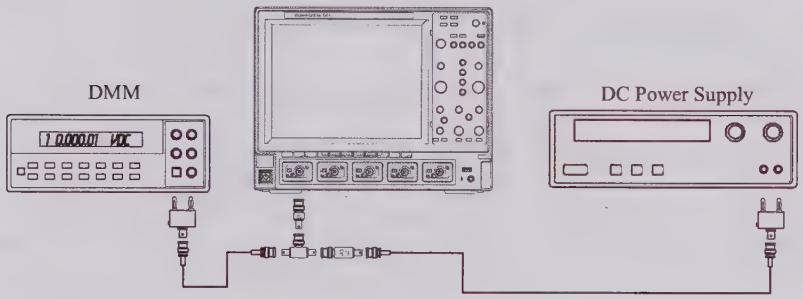



**Figure 5-5 : DC 1MΩ Accuracy Equipment Setup for 10 mV and 50 mV/div**

- For the range **100mV**, to **1 V/div** no attenuator is required, connect the test equipment as shown in Figure 5-6.

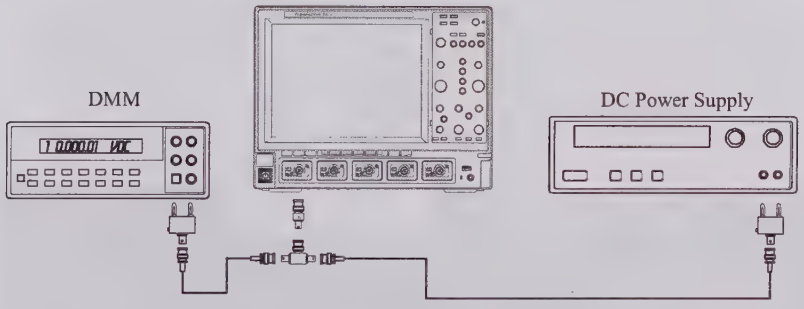



**Figure 5-6 : DC 1MΩ Accuracy Equipment Setup for 100 mV to 1 V/div.**

- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 8, column **PS output**.

  1) Connect the DMM and record the **voltage reading** in Table 8, column **DMM.**

  2) Press **Clear Sweeps**

  3) After 100 sweeps **PRESS STOP.** Read off the **DSO mean parameter** and record the measurement in Table 8, column **Mean**.

4) Moving the DC input repeat steps 2 and 3 for each channel setting the trigger to Auto.

- For each DC voltage applied to the DSO input repeat parts 1, 2, 3 and 4.

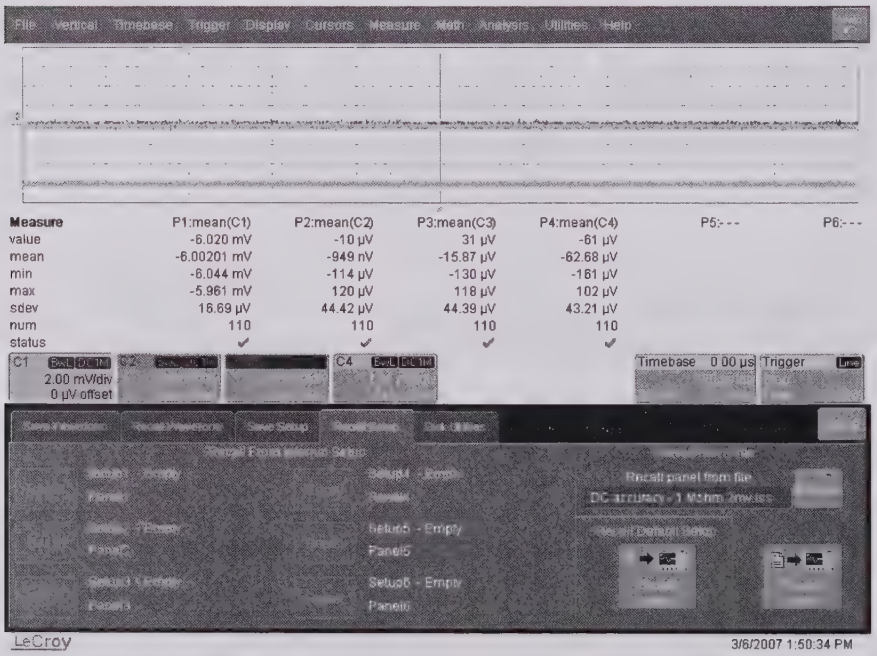
- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 8 and compare the **Difference ( Δ )** to the corresponding limit in the test record.

### 5.7.2 Negative 1MΩ DC Accuracy

- Recall **DC accuracy - 1 Mohm 2mv.lss** or configure the DSO as shown in 5.7.1.

- Connect the test equipment as shown in either Figure 5-4 or 5-5 or 5-6.

- For each **DSO Volts/div**, set the output of the external **DC voltage reference source** as shown in Table 9, column PS output. (if a banana-BNC adapter is being used it can simply be turned to get the opposite polarity)


File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
Measure P1:mean(C1) P2:mean(C2) P3:mean(C3) P4:mean(C4) P5:- - - P6:- - -
value -6.020 mV -10 µV 31 µV -61 µV
mean -6.00201 mV -949 nV -15.87 µV -62.68 µV
min -6.044 mV -114 µV -130 µV -161 µV
max -5.961 mV 120 µV 118 µV 102 µV
sdev 16.69 µV 44.42 µV 44.39 µV 43.21 µV
num 110 110 110 110
status
C1 DC 1M
2.00 mV/div
0 µV offset
C4 DC 1M
Timebase 0.00 µs
Trigger
Recall panel from file
Setup5 - Empty
Panel5
Setup6 - Empty
Panel6
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1) Connect the DMM and record the **voltage reading** in Table 9, column **DMM.**

2) Press **Clear Sweeps**

3) After 100 sweeps **PRESS STOP**. Read off the **DSO mean parameter** and record the measurement in Table 9, column **Mean**.

4) Moving the DC input repeat steps 2 and 3 for each channel setting the trigger

to Auto.

- For each DC voltage applied to the DSO input, repeat parts 1, 2, 3 and 4.
- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 9 and compare the **Difference ( Δ )** to the corresponding limit in the test record.

## 5.8 Offset Accuracy

### Specifications

±(1.5% of offset + 0.5% of FS + 1mv) for 44/62/64Xi models
±(1.5% of offset + 1.0% of FS + 1mv) for 104/204Xi models

### Description

The offset test is done at 50 mV/div, with a signal of ±0.750 Volt cancelled by an offset of the opposite polarity.

### 5.8.1 Positive 50Ω Offset Accuracy

### Procedure

- Recall **Offset - 50 ohm Positive.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 50Ω** on all 4 Channels |
| Input gain | : | **50mV/div** on all 4 Channels |
| Input offset | : | **+0.750 Volt** on all 4 Channels |
| BW Limit | : | **200MHz** |
| C1 Averaging | : | **1 sweeps** |
| C2 Averaging | : | **1 sweeps** |
| C3 Averaging | : | **1 sweeps** |
| C4 Averaging | : | **1 sweeps** |
| Trigger setup | : | **Edge** |
| Trigger on | : | **Line** |
| Mode | : | **Auto** |
| Time base | : | **50 ηsec/div.** |
| Active Channels | : | **4 (2 for 2 channel scope)** |
| Sampling mode | : | **Real Time** |
| Statistics | : | **on** |
| Change parameters | | |
| P1 | : | **Measure mean of C1** |
| P2 | : | **Measure mean of C2** |
| P3 | : | **Measure mean of C3** |
| P4 | : | **Measure mean of C4** |

- Connect the test equipment as shown in Figure 5-7.

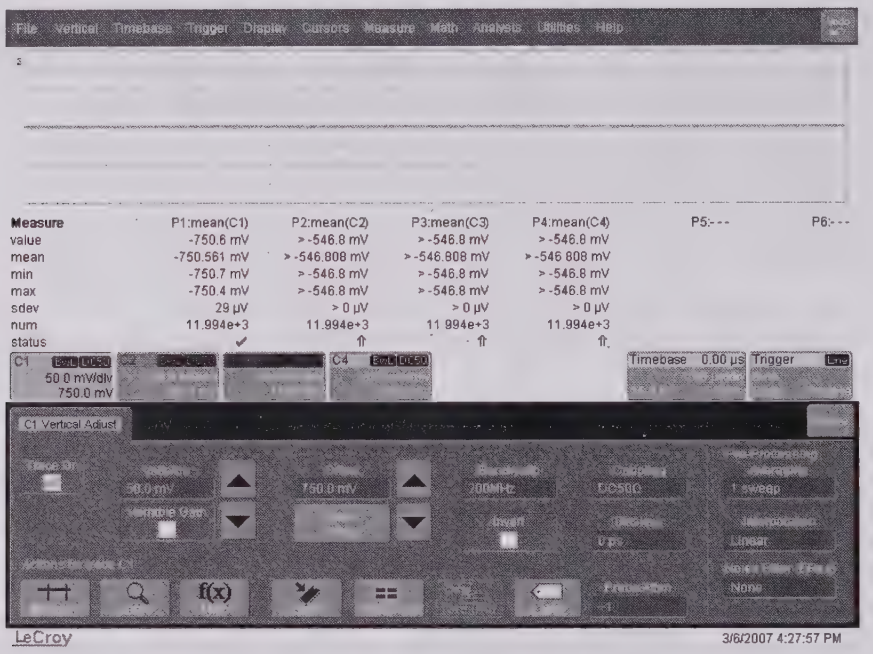
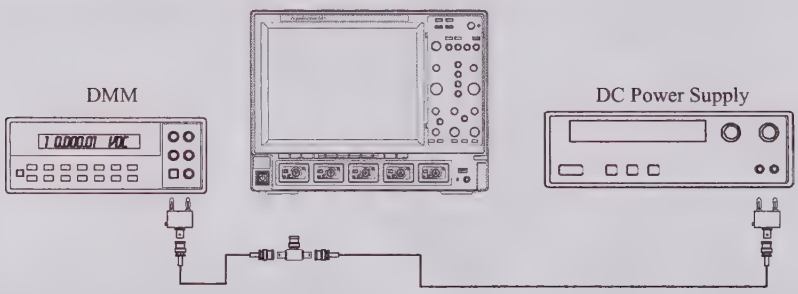

File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
Measure P1:mean(C1) P2:mean(C2) P3:mean(C3) P4:mean(C4) P5:--- P6:---
value -750.6 mV > -546.8 mV > -546.8 mV > -546.8 mV
mean -750.561 mV > -546.808 mV > -546.808 mV > -546.808 mV
min -750.7 mV > -546.8 mV > -546.8 mV > -546.8 mV
max -750.4 mV > -546.8 mV > -546.8 mV > -546.8 mV
sdev 29 µV > 0 µV > 0 µV > 0 µV
num 11.994e+3 11.994e+3 11.994e+3 11.994e+3
status
C1 50.0 mV/div 750.0 mV
C4
Timebase 0.00 µs
Trigger
C1 Vertical Adjust
750.0 mV
200MHz
1 sweep
Linear
None
LeCroy
3/6/2007 4:27:57 PM

**Figure 5-7 : Offset Accuracy Equipment Setup**




- Set the output of the external **DC voltage reference source until the DVM measures –0.750 Volt.**
  1) Record the **voltage reading** in Table10, column **DMM**.
  2) Press **Clear Sweeps**
  3) After 100 sweeps **PRESS STOP.** Read off the **DSO Mean parameter** voltage and record the measurement in Table 10 column **Mean**.

  4) Moving the DC input repeat steps 1 through 3 for each channel setting the trigger to Auto

- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 10 and compare the **Difference ( Δ )** to the corresponding limit in the test record.

### 5.8.2 Negative 50Ω Offset Accuracy

#### Procedure

- Recall **Offset - 50 ohm Negative.lss** or configure the DSO as shown in 5.8.1 and for each channel make the following change :

  Input offset: **–0.750 Volt** on all 4 Channels

- Connect the test equipment as shown in Figure 5-7.

- Set the output of the external **DC voltage reference source until the DMM measures +0.750 Volt).**
  1) Record the **voltage reading** in Table 11 column **DMM.**

  2) Press **Clear Sweeps**

  3) After 100 sweeps **PRESS STOP**. Read off the **DSO Mean parameter** voltage and record the measurement in Table 11 column **Mean**.

  4) Moving the DC input repeat steps 1 through 3 for each channel setting the trigger to Auto.

- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 11 and compare the **Difference ( Δ )** to the corresponding limit in the test record.

### 5.8.3 Positive 1MΩ Offset Accuracy

**Procedure**

- Recall **Offset - 1 Mohm Positive.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 1MΩ** on all 4 Channels |
| Input gain | : | **50mV/div** on all 4 Channels |
| Input offset | : | **+0.750 Volt** on all 4 Channels |
| BW Limit | : | **200MHz** |
| C1 Averaging | : | **1 sweeps** |
| C2 Averaging | : | **1 sweeps** |
| C3 Averaging | : | **1 sweeps** |
| C4 Averaging | : | **1 sweeps** |
| Trigger setup | : | **Edge** |
| Trigger on | : | **Line** |
| Mode | : | **Auto** |
| Time base | : | **50 ηsec/div.** |
| Active Channels | : | **4 (2 for 2 channel scope)** |
| Sampling mode | : | **Real Time** |
| Statistics | : | **on** |
| | | |
| Change parameters | | |
| P1 | : | **Measure mean of C1** |
| P2 | : | **Measure mean of C2** |
| P3 | : | **Measure mean of C3** |
| P4 | : | **Measure mean of C4** |

- Connect the test equipment as shown in Figure 5-7.

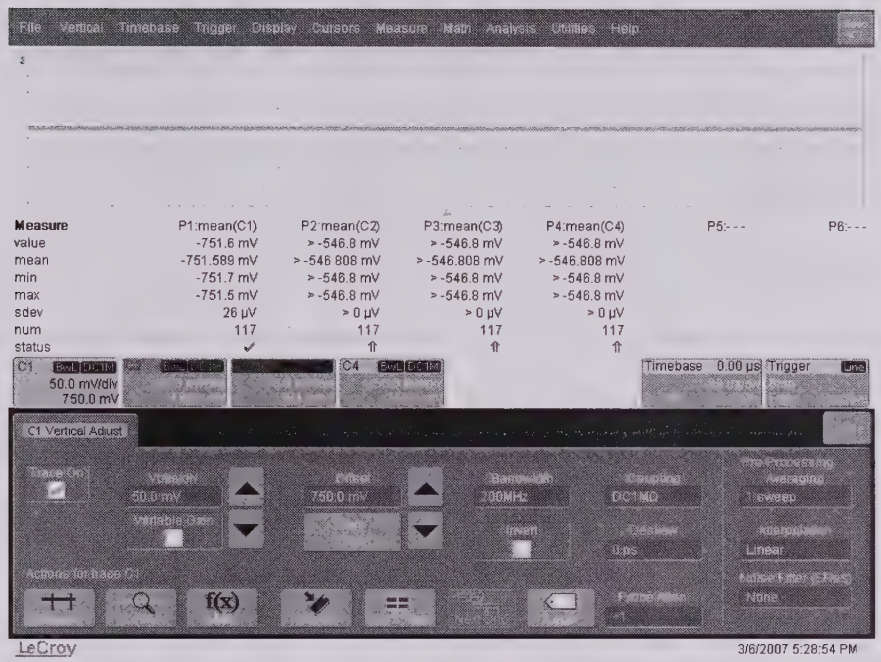
  - Set the output of the external **DC voltage reference source until the DVM measures –0.750 Volt.**

1) Record the **voltage reading** in Table 12, column **DMM**.

2) Press **Clear Sweeps**

3) After 100 sweeps **PRESS STOP**. Read off the **DSO Mean parameter** voltage and record the measurement in Table 12 column **Mean**.

4) Moving the DC input repeat steps 1 through 3 for each channel setting the trigger to Auto.




- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading.

- Record the test result in Table 12 and compare the **Difference ( Δ )** to the corresponding limit in the test record.

### 5.8.4 Negative 1MΩ Offset Accuracy

**Procedure**

- Recall **Offset - 1 Mohm Negative.lss** or configure the DSO as shown in 5.8.1 and for each channel make the following change :
  Input offset: **–0.750 Volt** on all 4 Channels. Connect the test equipment as shown in Figure 5-7.

- Set the output of the external **DC voltage reference source until the DMM measures +0.750 Volt.**
  1) Record the **voltage reading** in Table 13, column **DMM**.
  2) Press **Clear Sweeps**
  3) After 100 sweeps **PRESS STOP**. Read off the **DSO Mean parameter** voltage and record the measurement in Table 13 column **Mean**.

  4) Moving the DC input repeat steps 1 through 3 for each channel setting the trigger to Auto.

- Calculate the **Difference ( Δ )** by subtracting the **DMM voltage** reading from the **DSO mean** voltage reading. Record the test result in Table 13 and compare the **Difference ( Δ )** to the corresponding limit in the test record.

## 5.9 Bandwidth

### 5.9.1 Description

The purpose of this test is to ensure that the entire system has a bandwidth of at least 600 MHz for a WaveRunnner 64Xi & 62Xi, 400 MHz for a WaveRunnner 44Xi, 1000 MHz for the 104Xi and 2000 MHz for the WaveRunnner 204Xi. An external source is used as the reference to provide a signal where amplitude and frequency are well controlled.
The amplitude of the generator and cable as a function of frequency and power is calibrated using an HP8482A sensor on an HP437B power meter or equivalent. Note: If a leveled generator is used then the corrections needed by using the power meter may not be necessary.

### Specifications

**WaveRunnner - 64Xi or 62Xi**
**50Ω :** DC to at least 600 MHz (-3 dB)

**WaveRunnner - 44Xi**
**50Ω :** DC to at least 400 MHz (-3 dB)

**WaveRunnner - 104Xi**
**50Ω :** DC to at least 1000 MHz (-3 dB)

**WaveRunnner - 204Xi**
**50Ω :** DC to at least 2000 MHz (-3 dB)

- Recall **Bandwidth - CH1 10mv.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 50Ω** on all 4 Channels |
| Input gain | : | **10 mV/div** on all 4 Channels |
| Input offset | : | **0 mV** on all 4 Channels |
| Trigger setup | : | **Edge** |
| Trigger on | : | **CH 1** |
| Trigger level | : | **0.00mV** |
| Slope line | : | **Pos** |
| Mode | : | **Auto** |
| Time base | : | **50 ηsec/div**. |
| Active Channels | : | **4 (2 for 2 channel scope)** |
| Sampling mode | : | **Real Time** |
| Change parameters | | |
| P1 | : | **Sdev of C1** |
| P2 | : | **Freq of C1** |

- Connect the HP8482A power sensor to the power meter.
- Zero and **calibrate** the HP8482A power sensor using the power meter **Power Ref output**.
- Connect a **BNC adapter** to the HP8482A power sensor.
- Connect a 50Ω SMA cable to the **RF output** of the HP8648B/C generator and then through the necessary adapters to the power sensor. It is very important that the same cable/generator be used throughout this BW procedure and that the SMA connectors are torqued at all their mating locations.

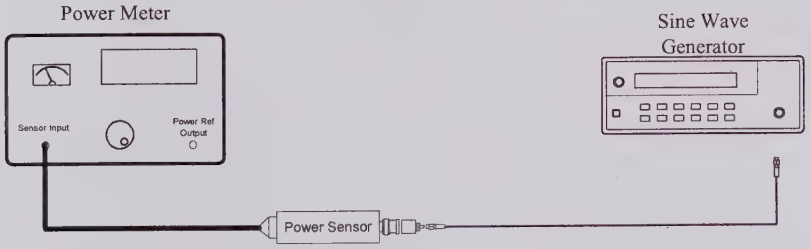



**Figure 5-8 : Power Meter Equipment Setup**

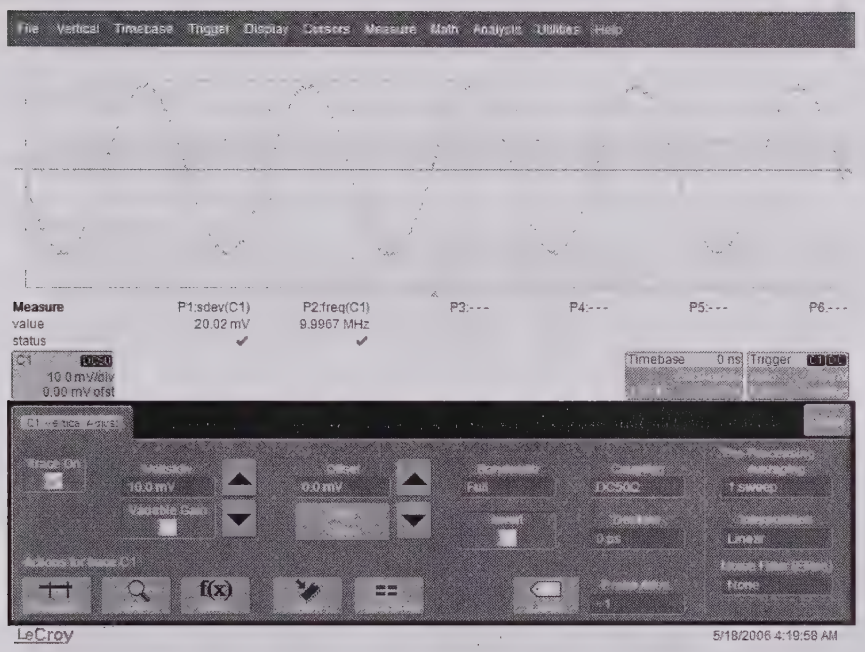
- Set the generator frequency to **10 MHz**
- Set the generator amplitude to measure **8 µW** on the power meter.
- Read the displayed **generator output amplitude,** and record it as generator

amplitude in the 10MHz section in table 14,10 mV/div bandwidth Test Record

- Repeat the above measurement for the appropriate scope model, **400.1 MHz, 600.1 MHz, 1000.1 MHz & 2000.1 MHz** as well as for different V/div settings. Record the generator output amplitude readouts in the fourth column of Table 14.
- Disconnect the **RF output** of the HP8648B/C generator from the power sensor.
- Connect the **RF output** of the HP8648B/C generator through the same cable that was calibrated in the previous step into Channel 1.

**Figure 5-9 : 50Ω Bandwidth Equipment Setup**

- Set the generator frequency to **10 MHz**.
- From the generator, apply the **recorded generator signal amplitude** to the Channel 1 input connector.
- Measure the value of **Sdev(1)** in Table 14.




- Increase the frequency of the generator to the maximum bandwidth of the scope model under test. Apply the **recorded generator signal amplitude** so the power remains constant, and record the Sdev value for channel 1 in table14.

- Repeat the above 3 steps for Channel 2, (**Bandwidth – CH2 10mv.lss**) 3 (**Bandwidth – CH3 10mv.lss**) & 4 (**Bandwidth – CH4 10mv.lss**) substituting channel controls, trigger settings and input connector. Record the measurements in Table 14.

- Calculate the ratio to 10 MHz for each channel, $sdev_{600.1}/sdev_{10}$ (for WaveRunnner 64Xi or 62Xi), $sdev_{400.1}/sdev_{10}$ (for WaveRunnner 44Xi), $sdev_{1000.1}/sdev_{10}$ (for WaveRunnner 104Xi) and $sdev_{2000.1}/sdev_{10}$ (for WaveRunnner 204Xi) compare the results to the limits in the test record.

- Repeat the above steps for V/div setting of 50 mV, 100 mV, and 500mV, using the appropriate **Bandwidth - CHx yymv.lss** (where x is channel and yy is V/div setting) panel setup and recording your results in Tables 15 through 17. Use the power setting and attenuators as shown in the tables.

## 5.10 Trigger Level

### Specifications

+/- (4% of Full Scale + 2mV)

### 5.10.1 Description

The trigger capabilities are tested for several cases of the standard edge trigger:

- Channel (internal), and External Trigger sources
- Three DC levels: –2.5, 0, +2.5 major screen divisions
- Positive and negative slopes

### 5.10.2 Channel Trigger at 0 Division Threshold

- Recall **Trigger - CH1 0 div pos slope.lss** or configure the DSO:

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels Trace ON | | **Channel 1, Channel 2, Channel 3 & Channel 4** |
| Input Coupling | : | **DC 50Ω** on all 4 Channels |
| Input gain | : | **100 mV/div.** on all 4 Channels |
| Input offset | : | **0 mV** on all 4 Channels (use show status to verify) |
| Trigger setup | : | **Edge** |
| Trigger on | : | **C1** |
| Slope 1 | : | **Pos** |
| Mode | : | **Auto** |
| Set Trigger level | : | **DC 0.0 mV** |
| Pre-Trigger Delay | : | **50 %** |
| Time base | : | **10 µsec/div.** |
| Active Channels | : | **4 (2 for 2 channel scope)** |
| Sampling mode | : | **Real Time** |
| | | |
| C1 Pre-Processing: | | **Averaging 10 sweeps** |
| C2 Pre-Processing: | | **Averaging 10 sweeps** |
| C3 Pre-Processing: | | **Averaging 10 sweeps** |
| C4 Pre-Processing: | | **Averaging 10 sweeps** |

- Set the output of the sine wave generator to **10 KHz.**
- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable as shown in Figure 5-10 and adjust the sine wave output amplitude to get **90% of full scale.**

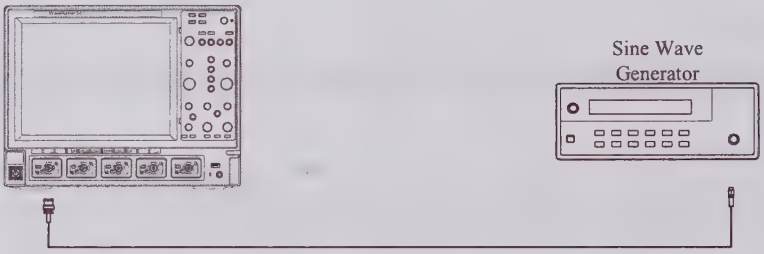
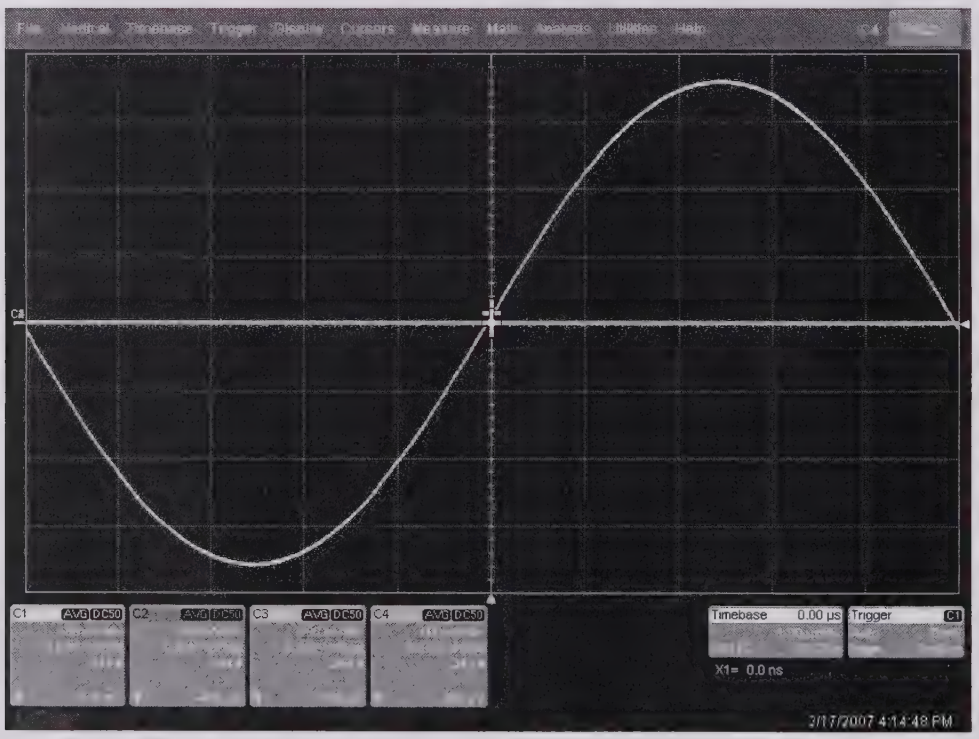



**Figure 5-10 Channel Trigger Equipment Setup**

- Select Measure: **Cursors, Horizontal Time**
- If needed use the "cursor position" knob, to move the **Time marker** at 0.0us

- Press **Clear Sweeps**,

- Acquire 10 sweeps and record in Table 18 the **mean of Horizontal Time**




**cursors** (average the two cursor values) displayed at the bottom of the trace descriptor box, to the bottom left of the grid

- Compare the test results to the corresponding limit in the test record. Set Trigger Slope 1 : **Neg**

- Acquire 10 sweeps and record in Table 18 the **mean of Horizontal Time cursors** (average the two cursor values) displayed at the bottom of the trace descriptor box, to the bottom left of the grid

- Set trigger to channels 2, 3 and 4 and for both POS and NEG slope, move input signal to appropriate channel and compare the test results to the corresponding limit in the test record.

### 5.10.3 Channel Trigger at +2.5 Divisions Threshold

- Recall **Trigger - CH1 +2.5 div pos slope.lss** or configure the DSO as shown in 5.10.2 and for each Channel make the following change :

  Set Trigger level : **DC +250 mV**

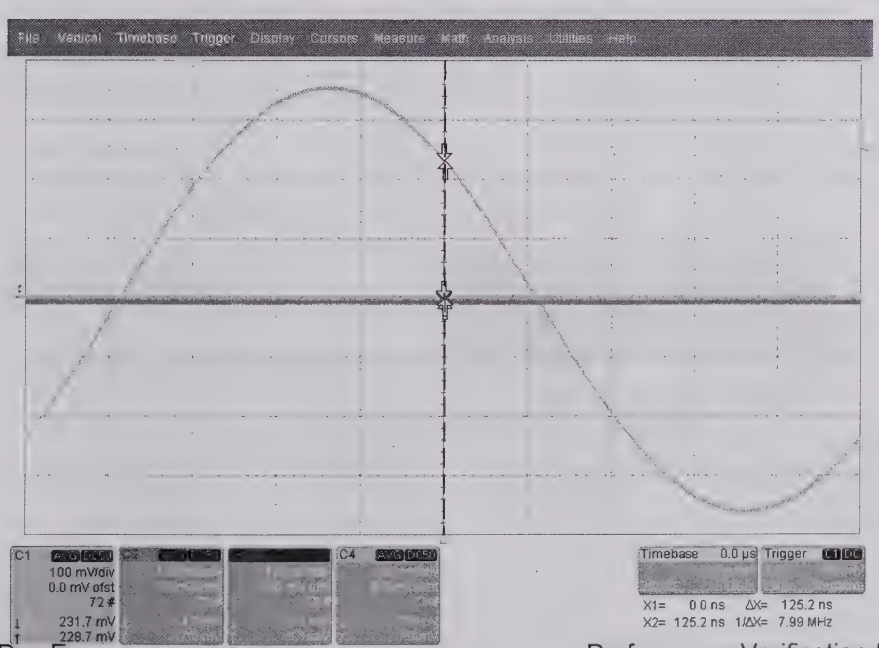
- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.
- Press **Clear Sweeps**,

- Acquire 10 sweeps and record in Table 18 the **mean of Horizontal Time cursors** (average the two cursor values) displayed at the bottom of the trace descriptor box, to the bottom left of the grid

- Compare the test results to the corresponding limit in the test record.

- Set Trigger Slope 1 : **Neg**

- Acquire 10 sweeps and record in Table 18 the **mean of Horizontal Time cursors** (average the two cursor values) displayed at the bottom of the trace descriptor box, to the bottom left of the grid



- Set trigger to channels 2, 3 and 4 and for both POS and NEG slope move input signal to appropriate channel and compare the test results to the corresponding limit in the test record.

### 5.10.4 Channel Trigger at –2.5 Divisions Threshold

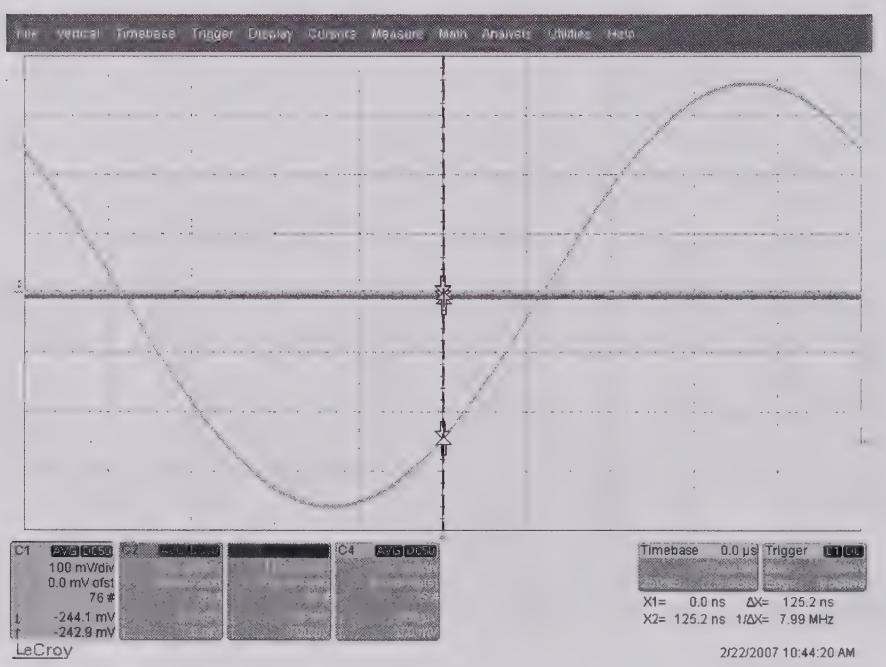
- Recall **Trigger - CH1 -2.5 div pos slope.lss** or configure the DSO as shown in 5.10.2 and for each channel make the following change :

  Set Trigger level : **DC –250 mV**
- Connect the output of the generator to Channel 1 through a 50 Ohm coaxial cable.

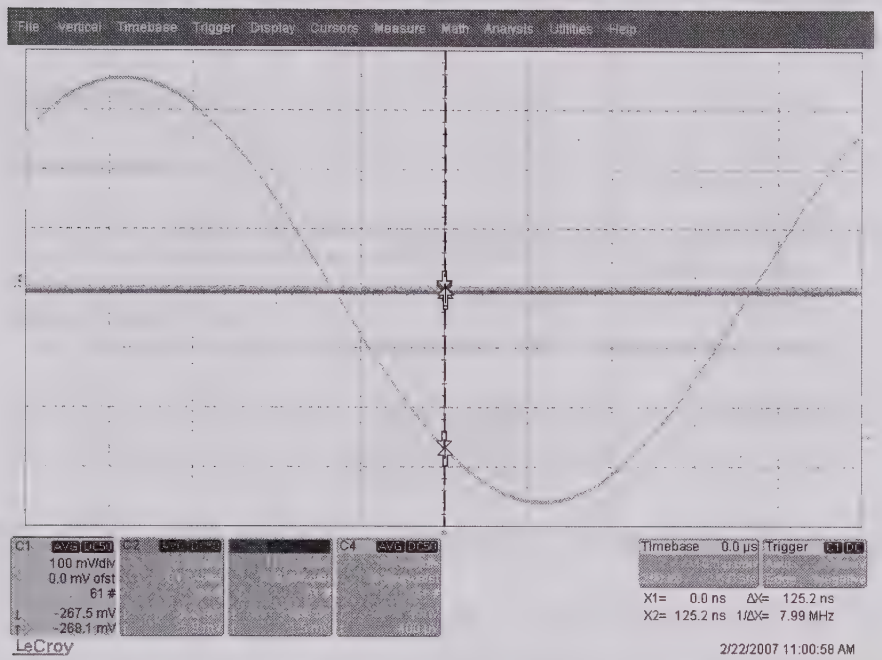
- Press **Clear Sweeps**,

- Acquire 10 sweeps and record in Table 18 the **mean of Horizontal Time cursors** (average the two cursor values) displayed at the bottom of the trace descriptor box, to the bottom left of the grid

- Compare the test results to the corresponding limit in the test record.




- Set Trigger Slope 1 : **Neg**




- Acquire 10 sweeps and record in Table 18 the **mean of Horizontal Time cursors** (average the two cursor values) displayed at the bottom of the trace descriptor box, to the bottom left of the grid
- Set trigger to channels 2, 3 and 4 and for both POS and NEG slope move input signal to appropriate channel and compare the test results to the corresponding limit in the test record.

## 5.11 Time Base Accuracy

### 5.11.1 Description

An external sine wave generator of **10.0 MHz** with frequency accuracy better than 1 PPM is used. The signal is sampled at a very slow sample rate to obtain high resolution. The frequency measured will be the error value.

**Specifications**

Timebase clock : accuracy : ≤ **±10 PPM @ 5°C - 40°C**

### 5.11.2 Time Base Clock Verification Procedure

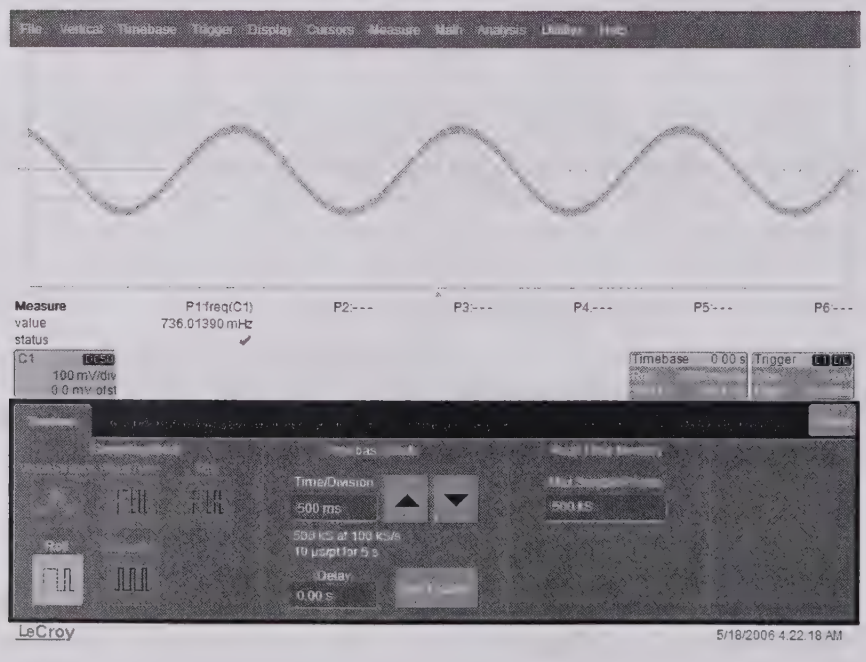
- Recall **Timebase Accuracy.lss** or configure the DSO

| | | |
|---|---|---|
| Panel Setups | : | **Recall FROM DEFAULT SETUP** |
| Channels trace ON | | **Channel 1** |
| Input gain | : | **.1 V/div.** |
| Input offset | : | **0 mV** |
| Trigger setup | : | **Edge** |

| | | |
|---|---|---|
| Trigger on | : | **C1** |
| Slope 1 | : | **Pos** |
| Level 1 | : | **0.0 mV** |
| Trigger mode | : | **Norm** |
| Delay | : | **0 %** |
| Time base | : | **500 msec/div.** |
| Active Channels | : | **1** |
| Sampling mode | : | **Real Time** |
| Max Sample points: | | **500 kS minimum** |

| | | |
|---|---|---|
| Measure | : | **Parameters** |
| P1 | : | **Amplitude of C1** |
| P2 | : | **Frequency of C1** |

- Connect the **RF output** of the signal generator through a 50 Ohm coaxial cable into Channel 1.
- Set the generator frequency to **10.0 MHz**.
- Adjust the generator output amplitude to get **6 divisions peak to peak.**
- Read of the frequency parameter (to 2 decimal places) and record the value in Table 19.
- Verify that the error is less than 100 Hz.



# 6. Maintenance

## 6.1 Introduction

This section contains information necessary to disassemble, assemble, maintain, calibrate and troubleshoot the LeCroy WaveRunner Xi Series.

### 6.1.1 Safety Precautions

The symbol used in this manual indicates dangers that could result in personal injury.

The symbol used in this manual identifies conditions or practices that could damage the instrument.

The following servicing instructions are for use by qualified personnel only. Do not perform any servicing other than contained in service instructions. Refer to procedures prior to performing any service.

Exercise extreme safety when testing high energy power circuits. Always turn the power OFF, disconnect the power cord and discharge all capacitors before disassembling the instrument.

### 6.1.2 Anti-static Precautions

Any static charge that builds on your person or clothing may be sufficient to destroy CMOS components, integrated circuits, Gate array's.....etc.

In order to avoid possible damage, the usual precautions against static electricity are required.

- Handle the boards in anti-static boxes or containers with foam specially designed to prevent static build-up.
- Ground yourself with a suitable wrist strap.
- Disassemble the instrument at a properly grounded work station equipped with anti-static mat.
- When handling the boards, do not touch the pins.
- Stock the boards in anti-static bags.

## 6.2 Disassembly and Assembly Procedure

The disassembly and assembly procedures detailed below refer to the views of figures shown in section 8.

### 6.2.1 Disassembly Procedure

Please study the figures in section 8 before attempting disassembly. Before removing any parts from the LeCroy WaveRunner, be sure to read carefully the instructions referring to those parts, noting any precautions needed to avoid problems.

Note: Power is always present on the CPU motherboard and inside the Power Supply whenever the power cord is plugged into a power source. Remove the power cord from the instrument before removing or inserting any connectors to the CPU motherboard. Extreme caution should be taken in protecting the LCD face from damage (e.g. scratch marks, etc.) when handling, in particular when inserting or removing from the instrument.

#### a. Removal of the Back shell and Box Top

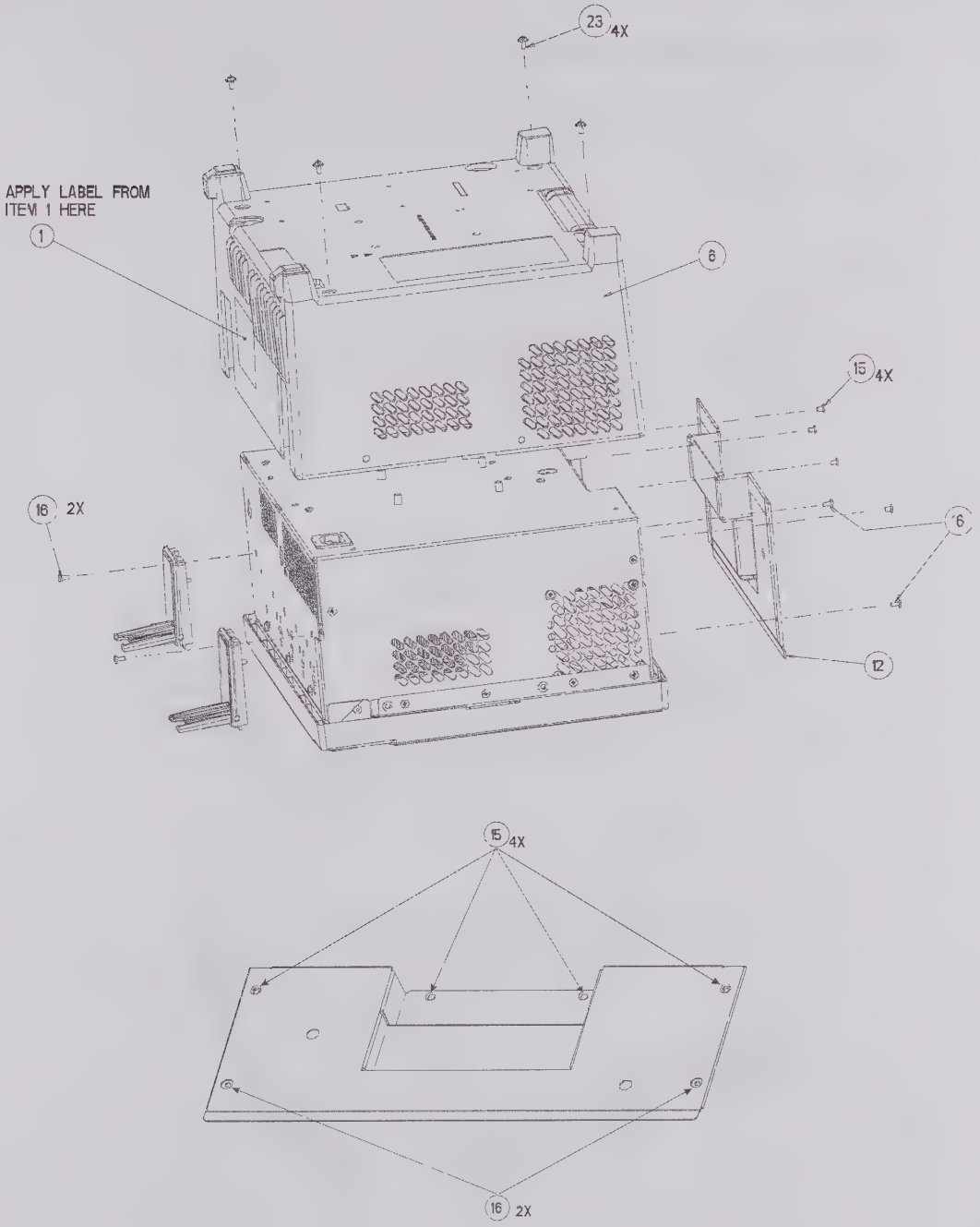
The upper cover disassembly procedure refers to the view of figure 8-1.

**Tools Needed**:

- T10 Torx driver
- T8 Torx driver
- #2 Philips screwdriver

**Procedure:**

- Remove four M3x6 ECO-fix screws (23) from the rear of the back shell
- Remove back shell (6)
- Remove four M3x5 Pan head screws (15)
- Remove two M3 flat undercut screws (16)
- Remove box top (12)


23 4X
APPLY LABEL FROM ITEM 1 HERE
1
6
15 4X
16 2X
6
12
15 4X
16 2X

## b. Removal of the Front Frame Assy

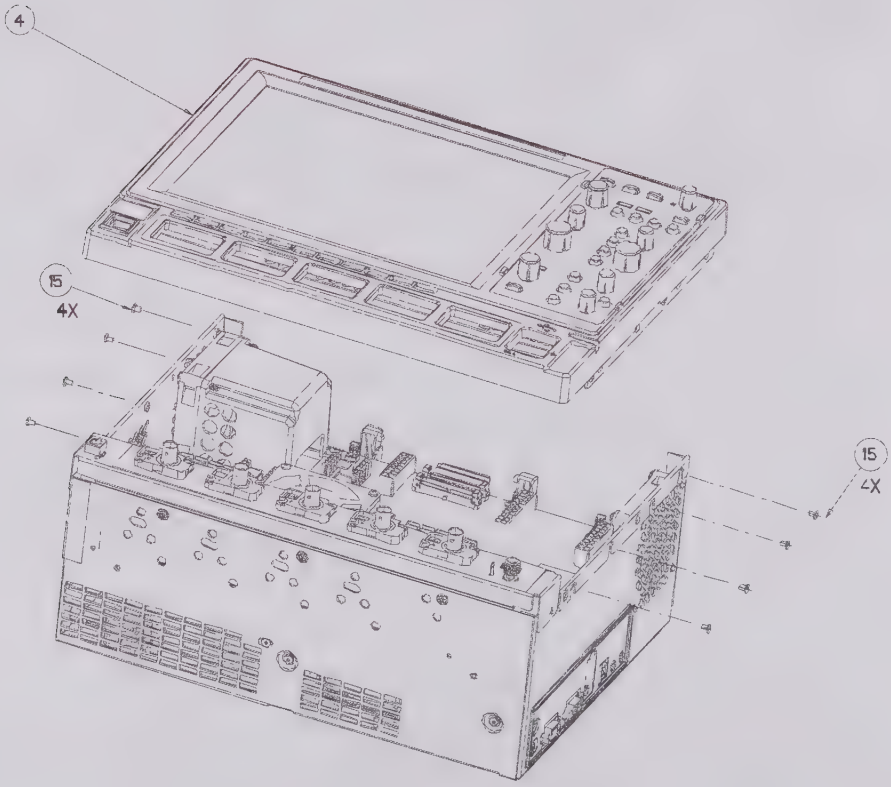
The front bezel disassembly procedure refers to the view of figure 8-2.

**Tools Needed**:

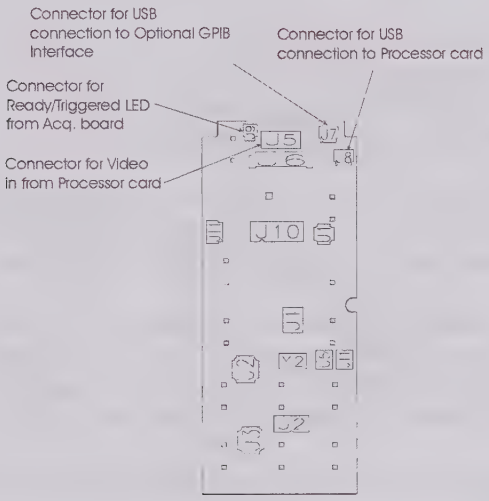
- T8 Torx driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove four M3 flat undercut screws (15) from each side of the front frame
- Slightly remove front bezel (4) from chassis



- Disconnect video cable at J5 of front panel
- Disconnect ready/trigger LED cable at J9 of front panel
- Disconnect USB cable at J8 of front panel
- Disconnect ribbon cable from hard drive
- Disconnect input power cable to bottom of TFT inverter board




- Remove front frame assy

### c. Removal of the Acquisition System Assembly

The Acquisition System removal procedure refers to the view of figure 8-1 & 8-4.

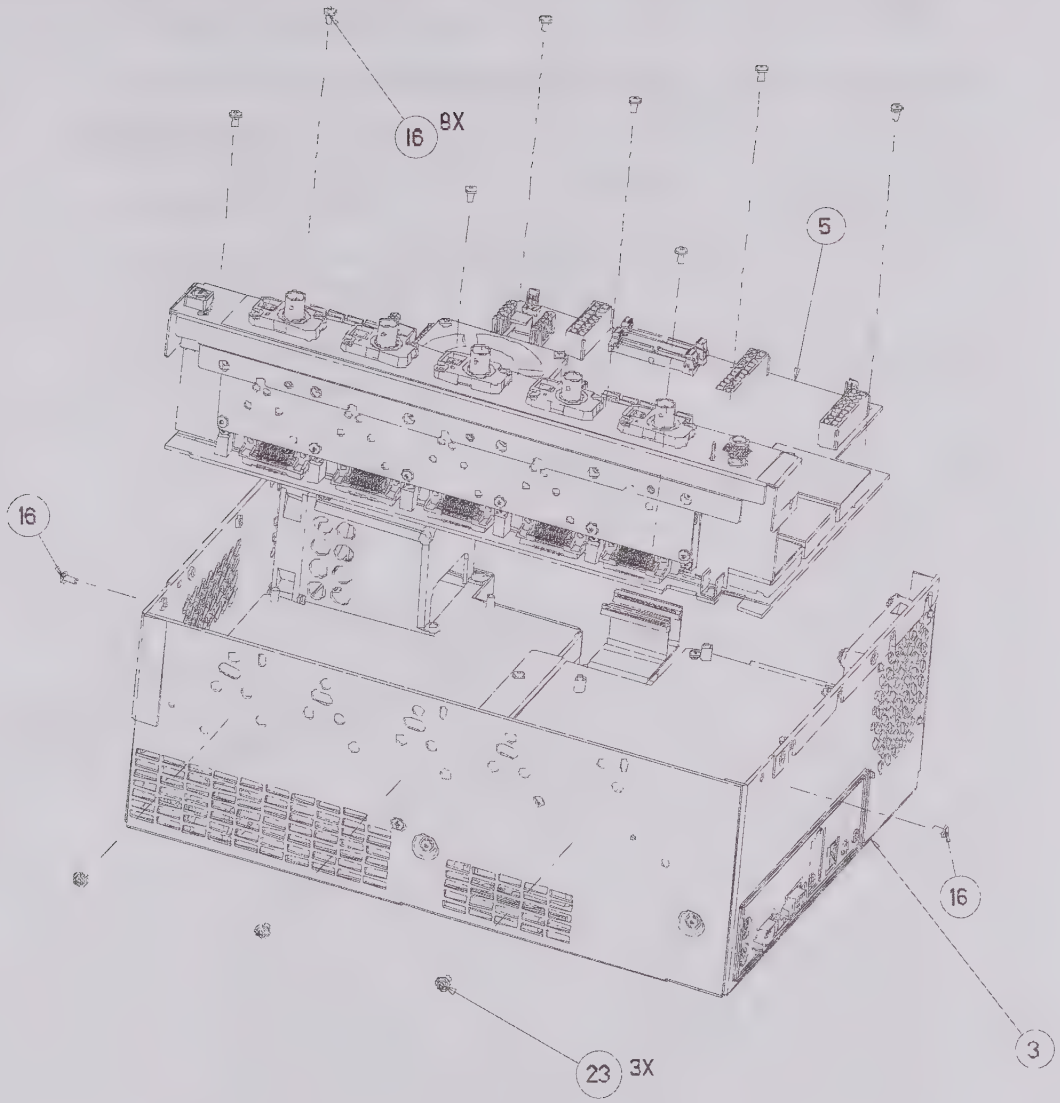
**Tools Needed**:

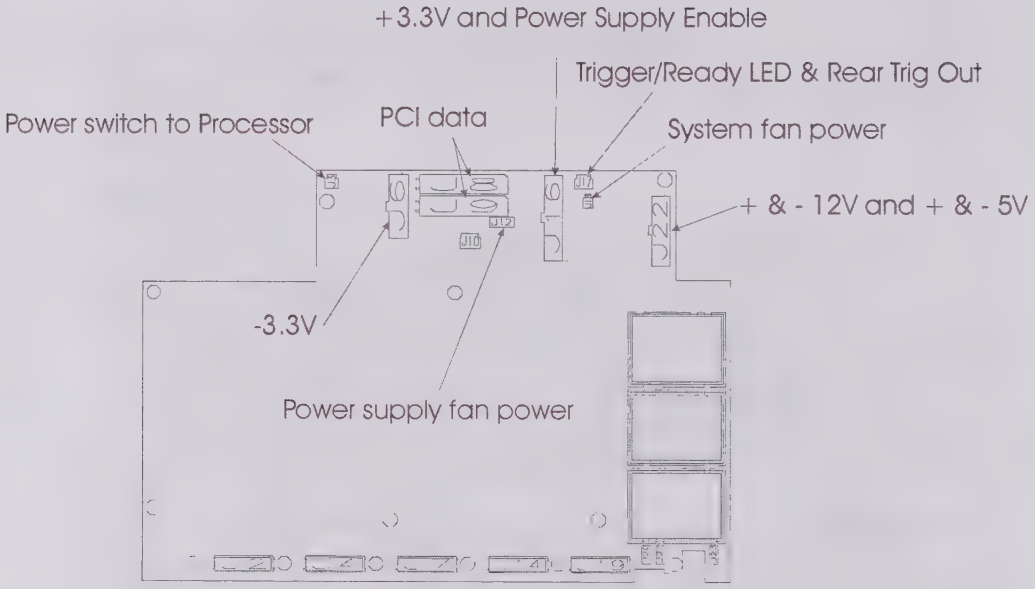
- Torx 10 Driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove Front frame assy (6.2.1.b)
- Remove one M3x6 screw (16) on each side
- Remove three M3x6 ECO-fix screws (23) from bottom of main card panel into bottom of chassis
- Disconnect three power cables to Acq board at location J6, J16 & J22
- Disconnect two ribbon cables to Acq board at locations J8 & J9
- Disconnect ready/trigger LED and rear trigger out cable from Acq Board at location J17
- Disconnect power switch cable to CPU motherboard at Acq Board location J3
- Disconnect power supply fan connector to Acq Board at location J12
- Disconnect right side system fan power cable from Acq board at location J18
- Disconnect USB cable at J22 of front end card (this is for the front panel USB cable)
- Remove eight M3x6 pan head screws (16) which secure the Acq board to the chassis
- Slightly tilt the acquisition board (5) to one side and remove from chassis (pay attention that USB cable to the front end card does not stuck)

The acquisition system can now be removed from the oscilloscope.


16 8X
5
16
16
3
23 3X


+3.3V and Power Supply Enable
Trigger/Ready LED & Rear Trig Out
Power switch to Processor
PCI data
System fan power
+ & - 12V and + & - 5V
-3.3V
Power supply fan power

### d. Removal of the Front End Card

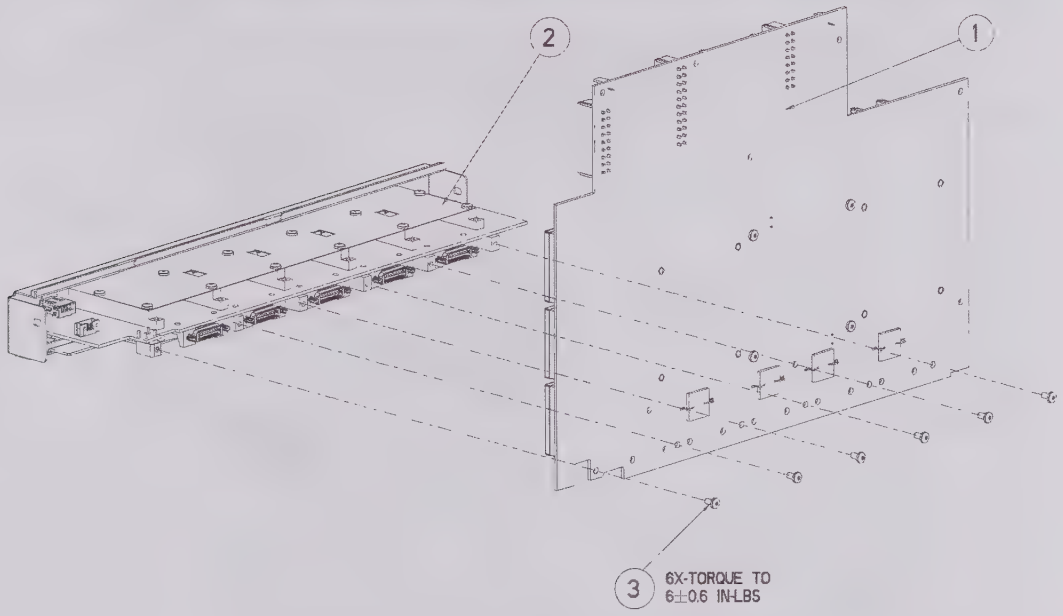
The PCI board removal procedure refers to the views of figure 8-5 and figure 8-9

**Tools Needed**:

- Torx 10 Driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove Front frame assy (6.2.1.b)
- Remove Acquisition system (6.2.1.c)
- Remove six M3x6 screws (3) which secure front end assy. (2) to acq. board (1)
- Remove front end ASSY (2)



### e. Removal of the Acquisition support plate

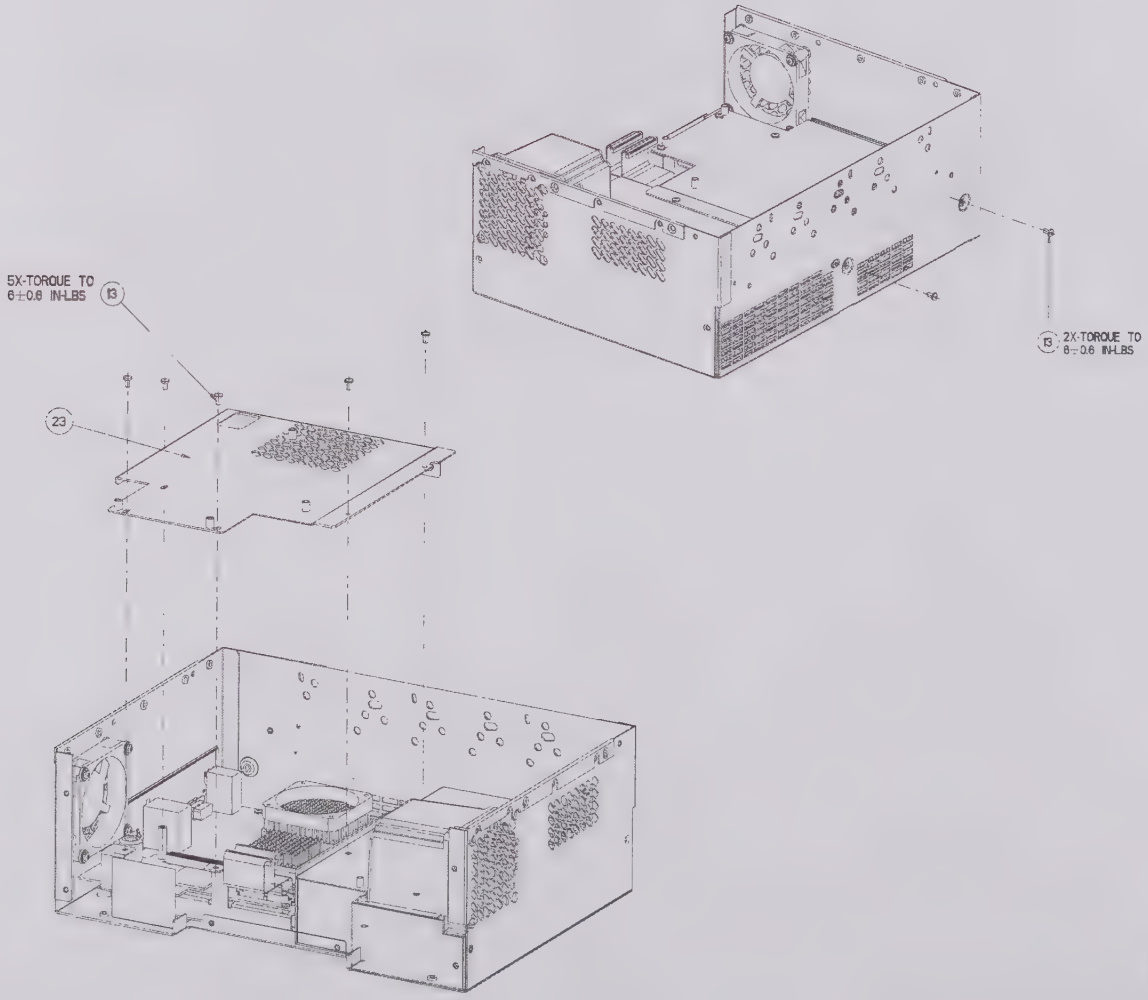
The PCI board removal procedure refers to the views of figure 8-5 and figure 8-9

**Tools Needed**:

- Torx 10 Driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove Front frame assy (6.2.1.b)
- Remove Acquisition system (6.2.1.c)
- Remove two M3x6 screws (13) through bottom of chassis to acquisition support plate
- Remove five M3x6 screws (13) from front side of acquisition support plate
- Remove acquisition support plate (23)



## f. Removal of the PCI Board

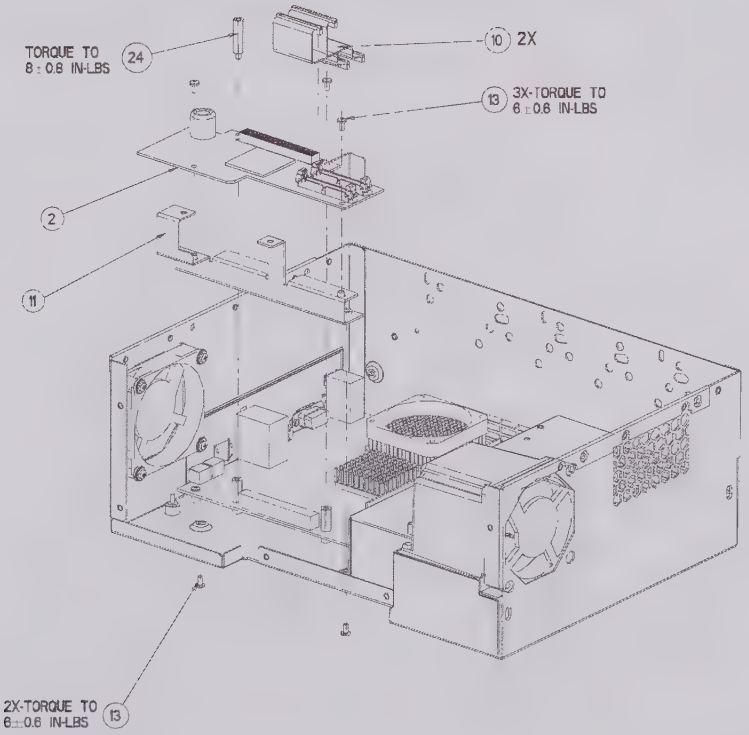
The PCI board removal procedure refers to the views of figure 8-5 and figure 8-9

**Tools Needed**:

- Torx 10 Driver
- ¼ " Nut Driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove Front frame assy (6.2.1.b)
- Remove Acquisition system (6.2.1.c)
- Remove acquisition support plate (6.2.1.e)
- Remove two M3x6 screws (13) which secure top edge of PCI card to PCI support bracket
- Remove one M3x23 standoff (24) and one M3x6 screw (13) which secure PC104+ connector of PCI card to CPU motherboard
- Remove PCI support bracket (11) by removing two M3x6 screws through the rear of the chassis
- Remove PCI card (2)



## g. Removal of the Power Supply

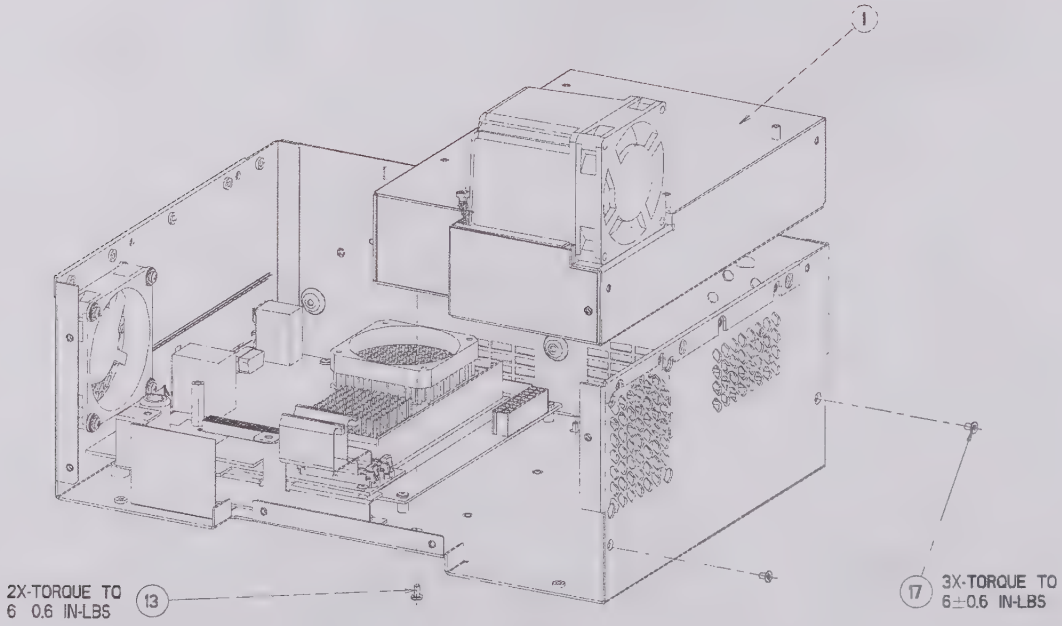
The power supply fan removal procedure refers to the views of figure 8-6.

**Tools Needed**:

- T10 Torx drive
- T8 Torx drive

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove Front frame assy (6.2.1.b)
- Remove Acquisition system (6.2.1.c)
- Remove acquisition support plate (6.2.1.e)
- Remove two M3 flat undercut screws (17) through the left side of chassis to the power supply
- Remove two M3x6 screws (13) through the rear of chassis to the power supply (note that the top screw has a washer)
- Remove one M3 flat undercut screw (17) through the bottom of the chassis to the power supply
- Disconnect power cable from processor card
- Remove the power supply (1)



### h. Removal of the Processor Board

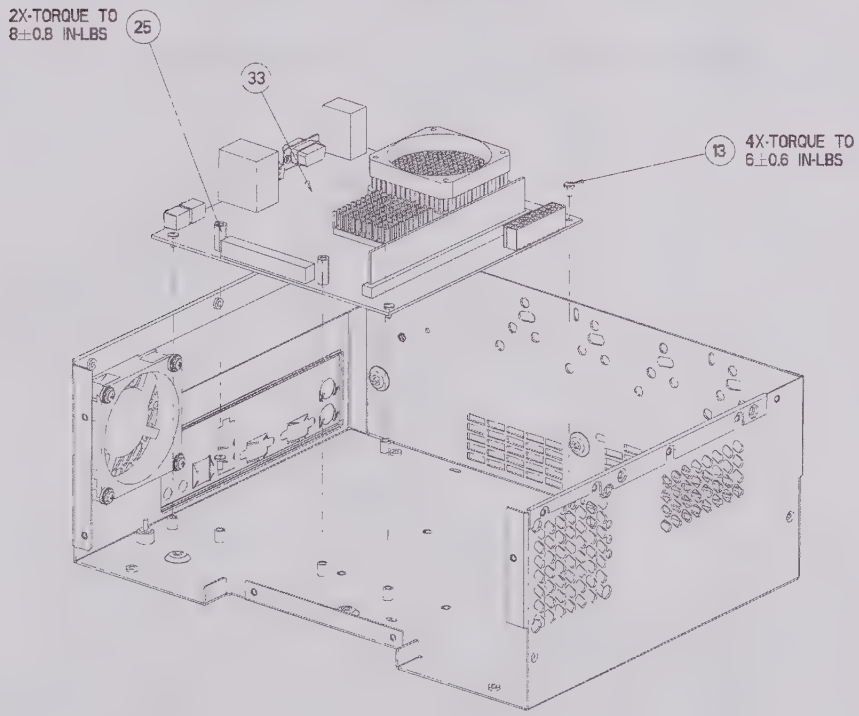
The processor board disassembly procedure refers to the views of figure 8-7 and figure 8-9.

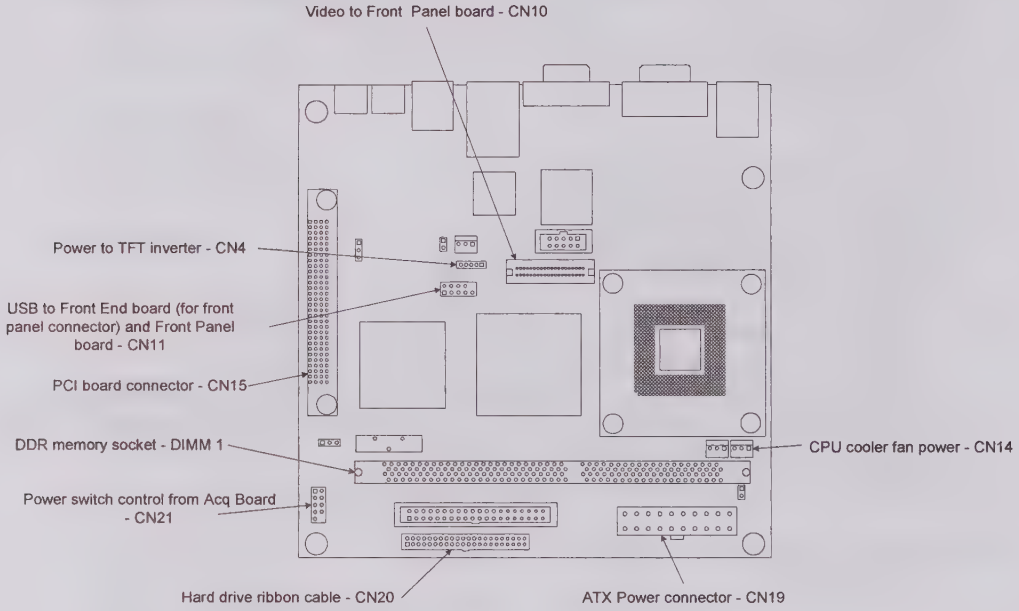
**Tools Needed**:

- Torx 10 Driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove Front frame assy (6.2.1.b)
- Remove Acquisition system (6.2.1.c)
- Remove acquisition support plate (6.2.1.e)
- Remove PCI card (6.2.1.f)
- Disconnect power cable from processor card
- Remove power supply (6.2.1.g)
- Remove four M3x6 screws (13) and two M3x15 standoffs (23) which secure the processor card to the chassis (a long screwdriver can be used to reach the screw which is underneath the right side system fan)
- Remove the processor card with its cables attached




Video to Front Panel board - CN10
Power to TFT inverter - CN4
USB to Front End board (for front panel connector) and Front Panel board - CN11
PCI board connector - CN15
DDR memory socket - DIMM 1
Power switch control from Acq Board - CN21
Hard drive ribbon cable - CN20
CPU cooler fan power - CN14
ATX Power connector - CN19

### i. Removal of the Front Frame

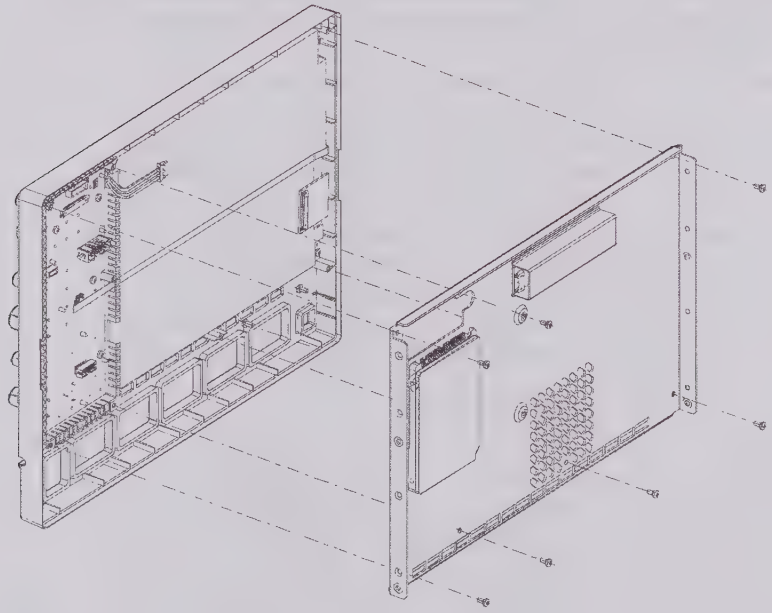
The hard disk drive removal procedure refers to the view of figure 8-7 and 8-9.

**Tools Needed**:

- #1 Philips screwdriver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove the front frame assy (6.2.1.b)
- Disconnect the TFT power cable from the DC-AC inverter
- Slide the bushing around the TFT power wires out from the front frame
- Remove seven M3x6 self tapping screws (X) which secure the front frame to the front bezel
- Remove the front frame (X)



## j. Removal of the Hard Drive

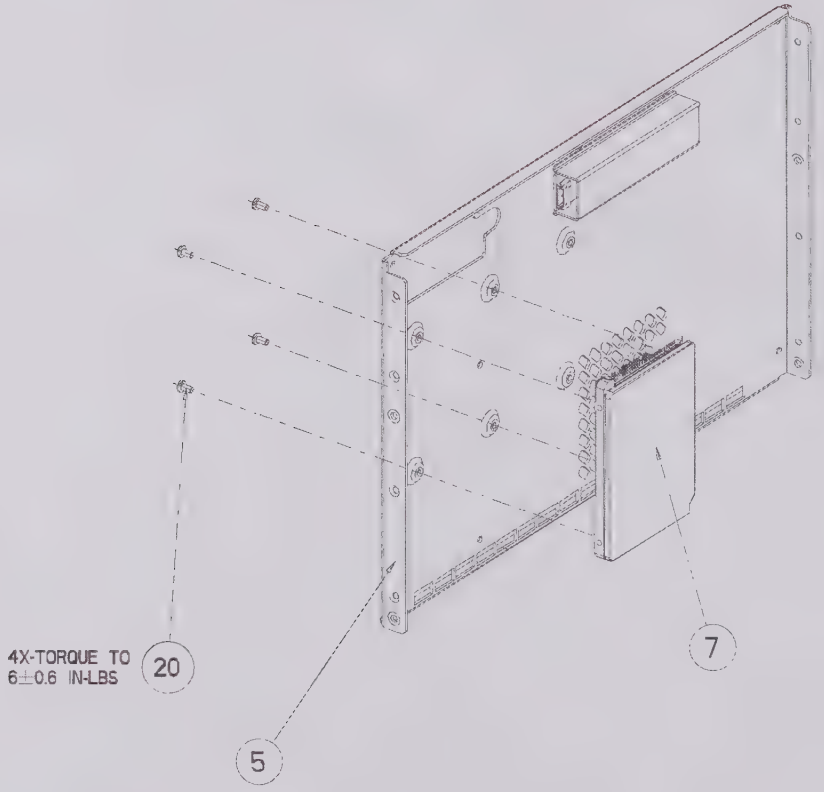
The hard disk drive removal procedure refers to the view of figure 8-7 and 8-9.

**Tools Needed**:

- Torx 10 Driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove the front frame assy (6.2.1.b)
- Remove the front frame (6.2.1.i)
- Disconnect the TFT power cable from the DC-AC inverter
- Slide the bushing around the TFT power wires out from the front frame
- Remove the four M3x6 screws (20) which secure the hard disk drive to the front frame (5)
- Remove the hard drive (7)



## k. Removal of the Front Panel Encoder Board

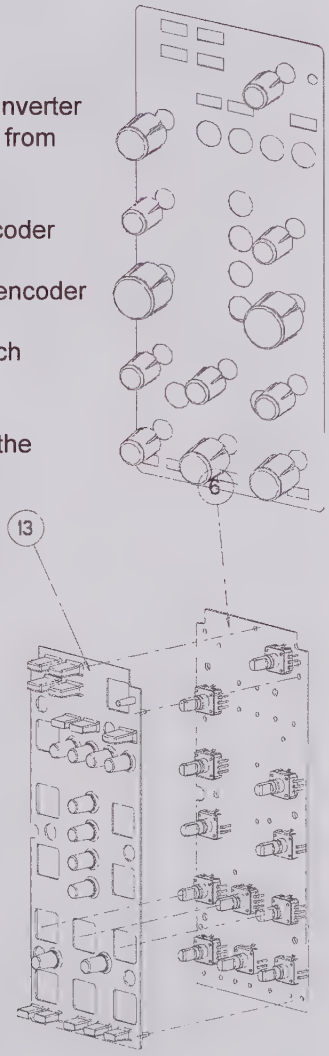
The front panel encoder board removal procedure refers to the views of figure 8-4 and figure 8-13.

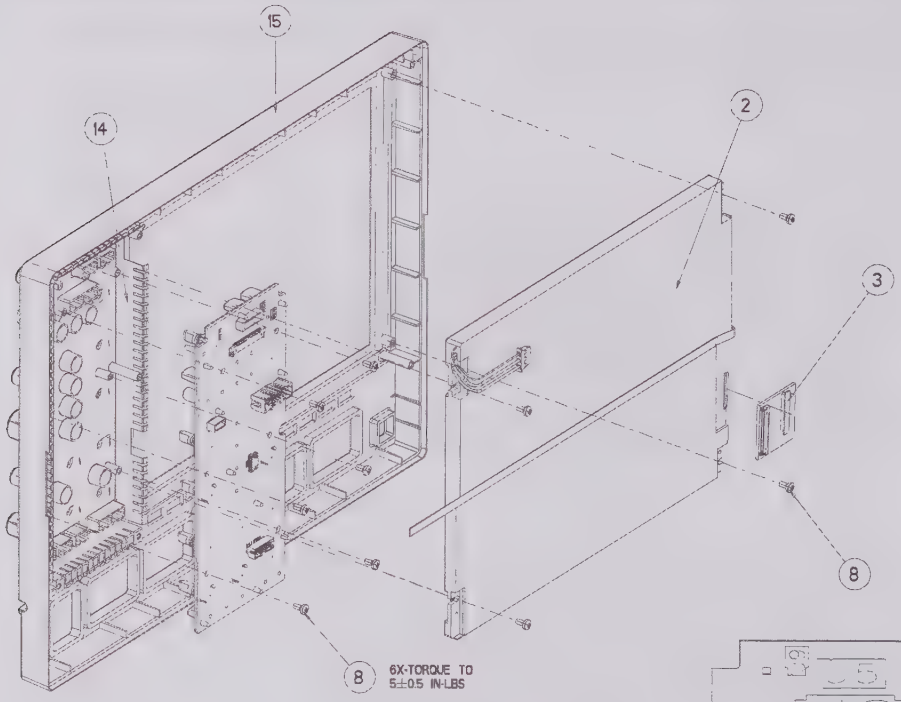
**Tools Needed**:

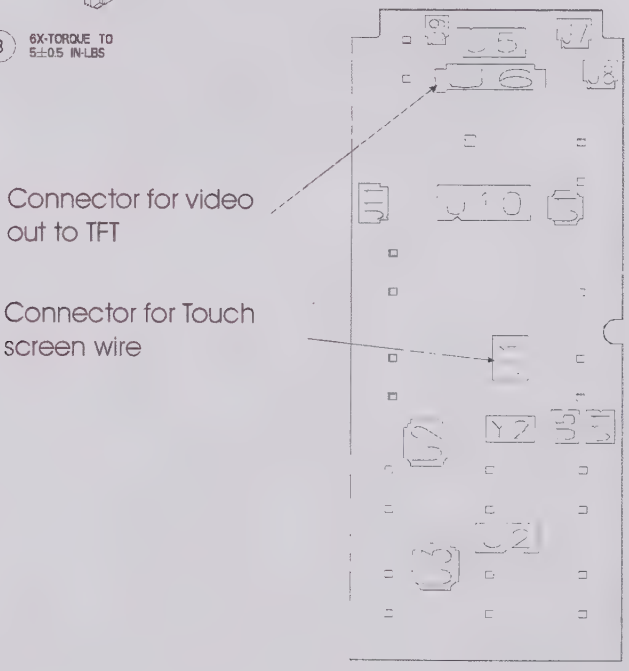
- T10 Torx driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove the front frame assy (6.2.1.b)
- Remove all of the knobs from the front panel
- Disconnect the TFT power cable from the DC-AC inverter
- Slide the bushing around the TFT power wires out from the front frame
- Remove the front frame (6.2.1.i)
- Disconnect the TFT video cable from J6 of the encoder board
- Disconnect the touch screen cable from J1 of the encoder board
- Remove the five M3x6 self tapping screws (8) which secure the encoder board to the front bezel
- Remove the front panel encoder board (6)
- Remove the elastomeric keypad (13) by grasping the rubber tabs which protrude through the PCB (6) and stretching them out slightly, this will cause them to loose their grip on the PCB and it can then be removed. Repeat for all tabs.




15
14
2
3
8
8
6X-TORQUE TO
5±0.5 IN-LBS


Connector for video
out to TFT
Connector for Touch
screen wire

## I. Removal of the Display Inverter Board

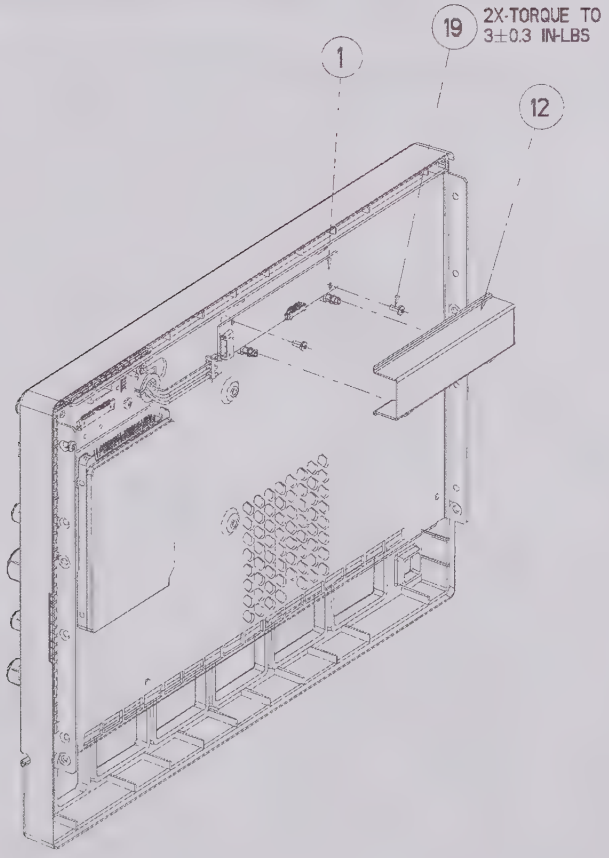
The display inverter removal procedure refers to the view of figure 8-4 & 8-16.

**Tools Needed**:

- T8 Torx driver

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove the front frame assy (6.2.1.b)
- Disconnect the TFT power cable from the DC-AC inverter
- Using a flat bladed screwdriver, unsnap the Inverter cover (12) from the posts on the front frame and slide the two tabs which secure the other edge of the shield out of the slots in the front frame.
- Remove the two M2.5x6 screws (19) which secure the display inverter (1) to the front frame.
- Remove the display inverter



## m. Removal of the Display and Touchscreen

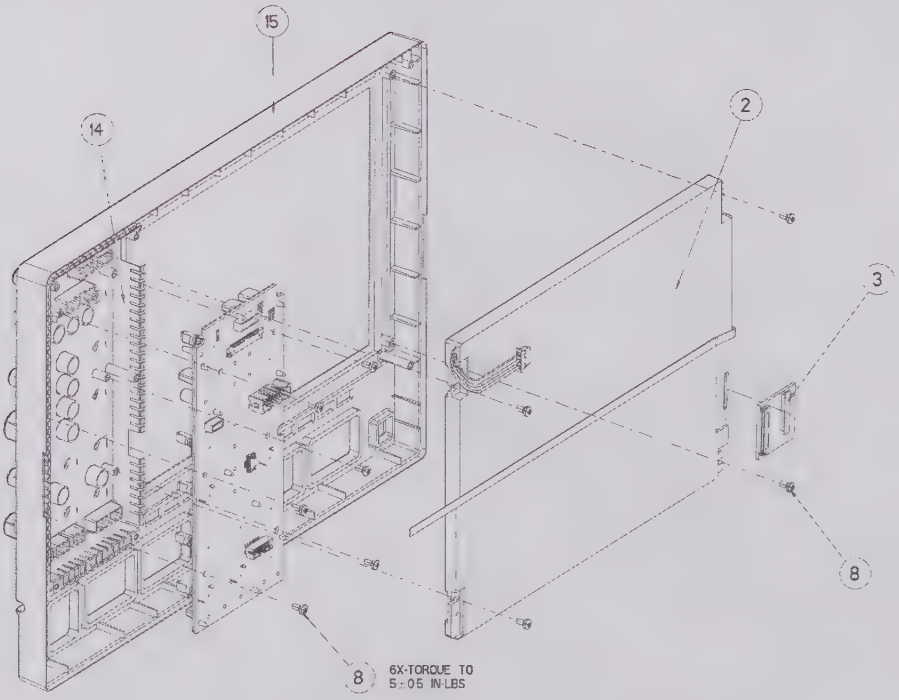
The display and touchscreen removal procedure refers to the view of figure 8-4, figure 8-15 and figure 8-16.

**Tools Needed**:

- T10 Torx driver
- #1 Philips

**Procedure:**

- Remove back shell & box top (6.2.1.a)
- Remove the front frame assy (6.2.1.b)
- Remove the front frame (6.2.1.i)
- Disconnect the TFT video cable from the VST board
- Unplug the VST board (3) from the TFT and remove from unit
- Remove the four M3x6 self tapping screws (8) which secure the TFT (2) to the front bezel
- Remove the TFT (2) from the front bezel



### n. Replacing the Battery

**⚠ WARNING**

There is a danger of explosion if the battery is incorrectly replaced. Replace the battery only with a CR2032 3V Lithium-Ion coin cell (or equivalent). The battery might content toxic substances and can cause environmental hazard if disposed of improperly, always dispose of used batteries according to the manufacturers instruction or local ordinances (where applicable).

A coin-cell battery (CR2032) powers the real-time clock and CMOS memory. When the scope is not plugged into a wall socket, the battery has an estimated life of three years. When the scope is plugged in, the standby current from the power supply extends the life of the battery. The clock is accurate to ±13 minutes/year at 25 °C with 3.3 VSB applied. When the voltage drops below a certain level, the BIOS Setup program settings stored in CMOS RAM (for example, the date and time) might not be accurate. Replace the battery with an equivalent one.

To replace the battery, follow these steps:

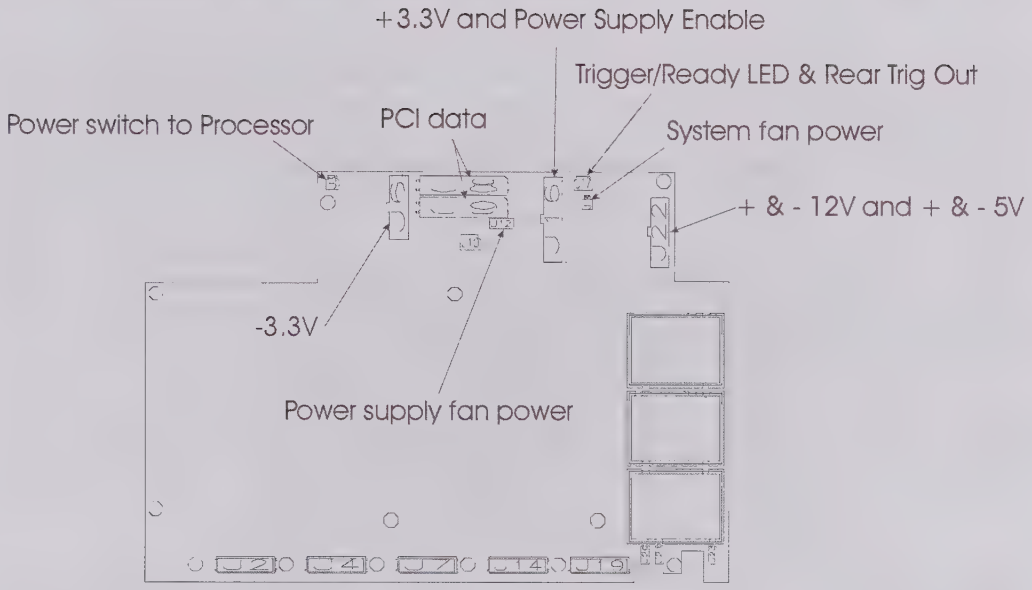
1. Turn off all peripheral devices connected to the computer. Disconnect the computer's power cord from the AC power source (wall outlet or power adapter).
2. Remove the Back Shell & Box Top (6.2.1.a)
3. Remove the Front Frame Assy (6.2.1.b)
4. Remove the Acquisition System (6.2.1.c)
5. Remove the Acquisition Support Plate (6.2.1.e)
6. Locate the battery on the board.
7. Gently push the retaining bar so that the battery can be lifted from its socket. Note the orientation of the "+" and "-" on the battery.
8. Install the new battery in the connector, orienting the "+" and "-" correctly.
9. Reassemble the instrument..

## Assembly Procedure

Reassemble the unit in the reverse order, check that all screws shown on the drawings in section 8 are used and have the proper torque. Verify that all cables are correctly connected.

**Assembly Note :**

- **Bezel** : The plastic bezel should not be in contact with the touch screen.
- **Fans** : Check the fan air flow, the fans blow air down into the unit.
- **Feet** : Check that the lower feet and rear feet are aligned and properly tightened before re-assembly.
- **CD**: Check that the tray moves freely and shuts correctly. Insert a CD and eject it to check the mechanism.
- **Front Panel** : Check that knobs rotate freely, are the right size and in the right place.
- **Acquisition Board** : Make sure that no heatsinks get knocked from their fully seated position as intimate contact is required between the heatsink and the devices.
- **Processor** : Check that all of the cables are correctly inserted. The BIOS must be flashed if new CPU card is installed.
- **Printer** : If the graphic printer is used, before closing the top cover don't forget to plug the input power cable to the option and the driver cable to the USB Hub card.
- **Hard Drive** – Hard Drive image will need to be restored (depends on version of CPU motherboard) Touch Screen calibration will need to be performed if hard drive is replaced. Critical files will need to be restored (see section 6.6) or full factory calibration performed.
- **PCI Card** – If board is replaced, software keys for software option licensing and model identification will need to be reissued.
- **USB Hub Card** – Make sure that video cable to TFT is tie-wrapped to the mounting block.

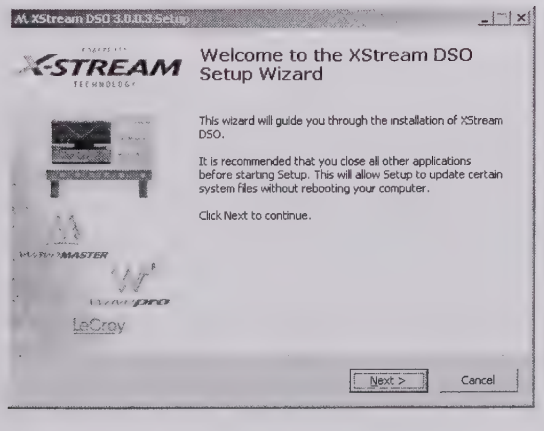

+3.3V and Power Supply Enable
Trigger/Ready LED & Rear Trig Out
Power switch to Processor
PCI data
System fan power
+ & - 12V and + & - 5V
-3.3V
Power supply fan power

## 6.3 Software Update Procedure

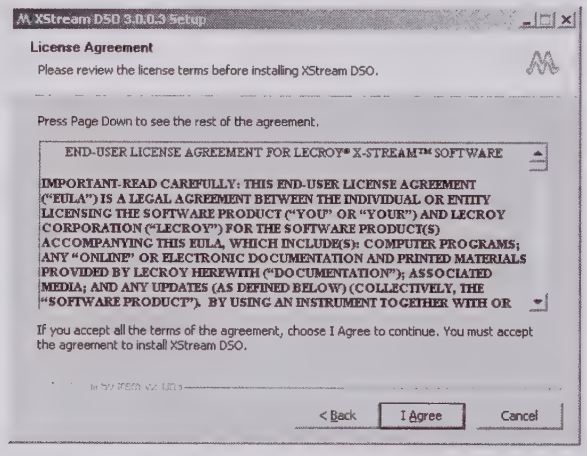
### 6.3.1 Installing New X-Stream DSO Application Software

In order to load new X-Stream DSO software the system must be capable of booting up to the Windows desktop.

- If the Wavemaster application is running, exit it through the File, Exit menu option.
- Insert the CD ROM containing the version to be installed into the CD ROM drive.
- From the windows desktop, select My Computer, then select the CD ROM drive.
- Launch XStreamDSOInstallerx.x.x.x.exe (where x.x.x.x is the version number) application.


XStream DSO 3.0.0.3 Setup
X-STREAM
Welcome to the XStream DSO Setup Wizard
This wizard will guide you through the installation of XStream DSO.
It is recommended that you close all other applications before starting Setup. This will allow Setup to update certain system files without rebooting your computer.
Click Next to continue.
MASTER
LeCroy
Next >
Cancel

- Press Next, You will be prompted to read and accept the software license agreement.


XStream DSO 3.0.0.3 Setup
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Please review the license terms before installing XStream DSO.
Press Page Down to see the rest of the agreement.
END-USER LICENSE AGREEMENT FOR LECROY® X-STREAM™ SOFTWARE
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< Back
I Agree
Cancel

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such acts as are necessary to achieve the Permitted Objective; (C) the information to be gained thereby has not already been made readily available to you or has not been provided by LeCroy within a reasonable time after a written request by you to LeCroy to provide such information; (D) the information gained is not used for any purpose other than the Permitted Objective and is not disclosed to any other person except as may be necessary to achieve the Permitted Objective; and (E) the information obtained is not used (1) to create a computer program substantially similar in its expression to the Software Product including, but not limited to, expressions of the Software Product in other computer languages, or (2) for any other act restricted by LeCroy's intellectual property rights in the Software Product. "Interoperability" will have the same meaning in this EULA as defined in the Digital Millennium Copyright Act, 17 U.S.C. §1201(f), the ability of computer programs to exchange information and of such programs mutually to use the information which has been exchanged.

**2. SUPPORT SERVICES.** At LeCroy's sole discretion, from time to time, LeCroy may provide Updates to the Software Product. LeCroy shall have no obligation to revise or update the Software Product or to support any version of the Software Product. At LeCroy's sole discretion, upon your request, LeCroy may provide you with support services related to the Software Product ("Support Services") pursuant to the LeCroy policies and programs described in the Documentation or otherwise then in effect, and such Support Services will be subject to LeCroy's then-current fees therefor, if any. Any Update or other supplemental software code provided to you pursuant to the Support Services will be considered part of the Software Product and will be subject to the terms and conditions of this EULA. LeCroy may use any technical information you provide to LeCroy during LeCroy's provision of Support Services, for LeCroy's business purposes, including for product support and development. LeCroy will not utilize such technical information in a form that personally identifies you.

**3. PROPRIETARY RIGHTS.**

3.1 Right and Title. All right, title and interest in and to the Software Product and Documentation (including but not limited to any intellectual property or other proprietary rights, images, icons, photographs, text, and "applets" embodied in or incorporated into the Software Product, collectively, "Content"), and all Derivatives, and any copies thereof are owned by LeCroy and/or its licensors or third-party suppliers, and is protected by applicable copyright or other intellectual property laws and treaties. You will not take any action inconsistent with such title and ownership. This EULA grants you no rights to use such Content outside of the proper exercise of the license granted hereunder, and LeCroy will not be responsible or liable therefor.

3.2 Intellectual Property Protection. You may not alter or remove any printed or on-screen copyright, trade secret, proprietary or other legal notices contained on or in copies of the Software Product or Documentation.

3.3 Confidentiality. Except for the specific rights granted by this EULA, neither party shall use or disclose any Confidential Information (as defined below) of the other party without the written consent of the disclosing party. A party receiving Confidential Information from the other shall use the highest commercially reasonable degree of care to protect the Confidential Information, including ensuring that its employees and consultants with access to such Confidential Information have agreed in writing not to disclose the Confidential Information. You shall bear the responsibility for any breaches of confidentiality by your employees and consultants. Within ten (10) days after request of the disclosing party, and in the disclosing party's sole discretion, the receiving party shall either return to the disclosing party originals and copies of any Confidential Information and all information, records and materials developed therefrom by the receiving party, or destroy the same, other than such Confidential Information as to which this EULA expressly provides a continuing right to the receiving party to retain at the time of the request. Either party may only disclose the general nature, but not the specific financial terms, of this EULA without the prior consent of the other party; provided either party may provide a copy of this EULA to any finance provider in conjunction with a financing transaction, if such provider agrees to keep this EULA confidential. Nothing herein shall prevent a receiving party from disclosing all or part of the Confidential Information as necessary pursuant to the lawful requirement of a governmental agency or when disclosure is required by operation of law; provided that prior to any such disclosure, the receiving party shall use reasonable efforts to (a) promptly notify the disclosing party in writing of such requirement to disclose, and (b) cooperate fully with the disclosing party in protecting against any such disclosure or obtaining a protective order. Money damages will not be an adequate remedy if this Section 4.3 is breached and, therefore, either party shall, in addition to any other legal or equitable remedies, be entitled to seek an injunction or similar equitable relief against such breach or threatened breach without the necessity of posting any bond. As used herein, "Confidential Information" means LeCroy pricing or information concerning new LeCroy products, trade secrets (including without limitation all internal header information contained in or created by the Software Product, all benchmark and performance test results and all Documentation) and other proprietary information of LeCroy; and any business, marketing or technical information disclosed by LeCroy, or its representatives, or you in relation to this EULA, and either (i) disclosed in writing and marked as confidential at the time of disclosure or (ii) disclosed in any other manner such that a reasonable person would understand the nature and confidentiality of the information. Confidential Information does not include information (A) already in the possession of the receiving party without an obligation of confidentiality to the disclosing party, (B) hereafter rightfully furnished to the receiving party by a third party without a breach of any separate nondisclosure obligation to the disclosing party, (C) publicly known without breach of this EULA, (d) furnished by the disclosing party to a third party without restriction on subsequent disclosure, or (e) independently developed by the receiving party without reference to or reliance on the Confidential Information.

**4. TERMINATION.** This EULA will remain in force until termination pursuant to the terms hereof. You may terminate this EULA at any time. This EULA will also terminate if you breach any of the terms or conditions of this EULA. You agree that if this EULA terminates for any reason, the License will immediately terminate and you will destroy all copies of the Software Product (and all Derivatives), installed or otherwise, the Documentation, and the Confidential Information (and all derivatives of any of the foregoing) that

are in your possession or under your control. The provisions of Sections 1.3, 4, 6, 7, 8, and 9 will survive any termination or expiration hereof.

**5. U.S. GOVERNMENT RESTRICTED RIGHTS.** If any Software Product or Documentation is acquired by or on behalf of a unit or agency of the United States Government (any such unit or agency, the "Government"), the Government agrees that the Software Product or Documentation is "commercial computer software" or "commercial computer software documentation" and that, absent a written agreement to the contrary, the Government's rights with respect to the Software Product or Documentation are, in the case of civilian agency use, Restricted Rights, as defined in FAR §52.227.19, and if for Department of Defense use, limited by the terms of this EULA, pursuant to DFARS §227.7202. The use of the Software Product or Documentation by the Government constitutes acknowledgment of LeCroy's proprietary rights in the Software Product and Documentation. Manufacturer is LeCroy Corporation, 700 Chestnut Ridge Road, Chestnut Ridge, NY 10977 USA.

**6. EXPORT RESTRICTIONS.** You agree that you will not export or re-export the Software Product, any part thereof, or any process or service that is the direct product of the Software Product (the foregoing collectively referred to as the "Restricted Components"), to any country, person, entity or end user subject to U.S. export restrictions. You specifically agree not to export or re-export any of the Restricted Components (a) to any country to which the U.S. has embargoed or restricted the export of goods or services, which currently include, but are not necessarily limited to Cuba, Iran, Iraq, Libya, North Korea, Sudan and Syria, or to any national of any such country, wherever located, who intends to transmit or transport the Restricted Components back to such country; (b) to any end user who you know or have reason to know will utilize the Restricted Components in the design, development or production of nuclear, chemical or biological weapons; or (c) to any end-user who has been prohibited from participating in U.S. export transactions by any federal agency of the U.S. government. You warrant and represent that neither the BXA nor any other U.S. federal agency has suspended, revoked or denied your export privileges. It is your responsibility to comply with the latest United States export regulations, and you will defend and indemnify LeCroy from and against any damages, fines, penalties, assessments, liabilities, costs and expenses (including reasonable attorneys' fees and court costs) arising out of any claim that the Software Product, Documentation, or other information or materials provided by LeCroy hereunder were exported or otherwise accessed, shipped or transported in violation of applicable laws and regulations.

**8. RISK ALLOCATION.**

8.1 No Warranty. THE SOFTWARE PRODUCT IS NOT ERROR-FREE AND THE SOFTWARE PRODUCT AND SUPPORT SERVICES IS/ARE BEING PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND. LECROY, FOR ITSELF AND ITS SUPPLIERS, HEREBY DISCLAIMS ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, ORAL OR WRITTEN, WITH RESPECT TO THE SOFTWARE PRODUCT OR ANY SUPPORT SERVICES INCLUDING, WITHOUT LIMITATION, ALL IMPLIED WARRANTIES OF TITLE OR NON-INFRINGEMENT, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY, INTEGRATION, VALIDITY, EXCLUSIVITY, MERCHANTABILITY, NON-INTERFERENCE WITH ENJOYMENT, FITNESS FOR ANY PARTICULAR PURPOSE, AND ALL WARRANTIES IMPLIED FROM ANY COURSE OF DEALING OR USAGE OF TRADE. YOU ACKNOWLEDGE THAT NO WARRANTIES HAVE BEEN MADE TO YOU BY OR ON BEHALF OF LECROY OR OTHERWISE FORM THE BASIS FOR THE BARGAIN BETWEEN THE PARTIES.

8.2. Limitation of Liability. LECROY'S LIABILITY FOR DAMAGES FOR ANY CAUSE WHATSOEVER, REGARDLESS OF THE FORM OF ANY CLAIM OR ACTION, SHALL NOT EXCEED THE GREATER OF THE AMOUNT ACTUALLY PAID BY YOU FOR THE SOFTWARE PRODUCT OR U.S.$5.00; PROVIDED THAT IF YOU HAVE ENTERED INTO A SUPPORT SERVICES AGREEMENT WITH LECROY, LECROY'S ENTIRE LIABILITY REGARDING SUPPORT SERVICES WILL BE GOVERNED BY THE TERMS OF THAT AGREEMENT. LECROY SHALL NOT BE LIABLE FOR ANY LOSS OF PROFITS, LOSS OF USE, LOSS OF DATA, INTERRUPTION OF BUSINESS, NOR FOR INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES OF ANY KIND, WHETHER UNDER THIS EULA OR OTHERWISE ARISING IN ANY WAY IN CONNECTION WITH THE SOFTWARE PRODUCT, THE DOCUMENTATION OR THIS EULA. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU. THESE LIMITATIONS ARE INDEPENDENT FROM ALL OTHER PROVISIONS OF THIS EULA AND SHALL APPLY NOTWITHSTANDING THE FAILURE OF ANY REMEDY PROVIDED HEREIN.

8.3 Indemnification. You will defend, indemnify and hold harmless LeCroy and its officers, directors, affiliates, contractors, agents, and employees from, against and in respect of any and all assessments, damages, deficiencies, judgments, losses, obligations and liabilities (including costs of collection and reasonable attorneys' fees, expert witness fees and expenses) imposed upon or suffered or incurred by them arising from or related to your use of the Software Product.

**9. GENERAL PROVISIONS.**

9.1 Compliance with Laws. You will comply with all laws, legislation, rules, regulations, and governmental requirements with respect to the Software Product, and the performance by you of your obligations hereunder, of any jurisdiction in or from which you directly or indirectly cause the Software Product to be used or accessed.

9.2 No Agency. Nothing contained in this EULA will be deemed to constitute either party as the agent or representative of the other party, or both parties as joint venturers or partners for any purpose.

9.3 Entire Agreement; Waiver; Severability. This EULA constitutes the entire agreement between the parties with regard to the subject matter hereof. No provision of, right, power or privilege under this EULA will be deemed to have been waived by any act, delay, omission or acquiescence by LeCroy, its agents, or employees, but only by an instrument in writing signed by an authorized officer of LeCroy. No waiver by LeCroy of any breach or default of any provision of this EULA by you will be effective as to any other breach or default, whether of the same or any other provision and whether occurring prior to, concurrent with, or subsequent to the date of such waiver. If any provision of this EULA is declared by a court of competent jurisdiction to be invalid, illegal or unenforceable, such

provision will be severed from this EULA and all the other provisions will remain in full force and effect.

9.4 Governing Law; Jurisdiction; Venue. This EULA will be governed by and construed in accordance with the laws of the State of New York, USA, without regard to its choice of law provisions. The United Nations Convention on Contracts for the International Sale of Goods will not apply to this EULA. Exclusive jurisdiction and venue for any litigation arising under this EULA is in the federal and state courts located in New York, New York, USA and both parties hereby consent to such jurisdiction and venue for this purpose.

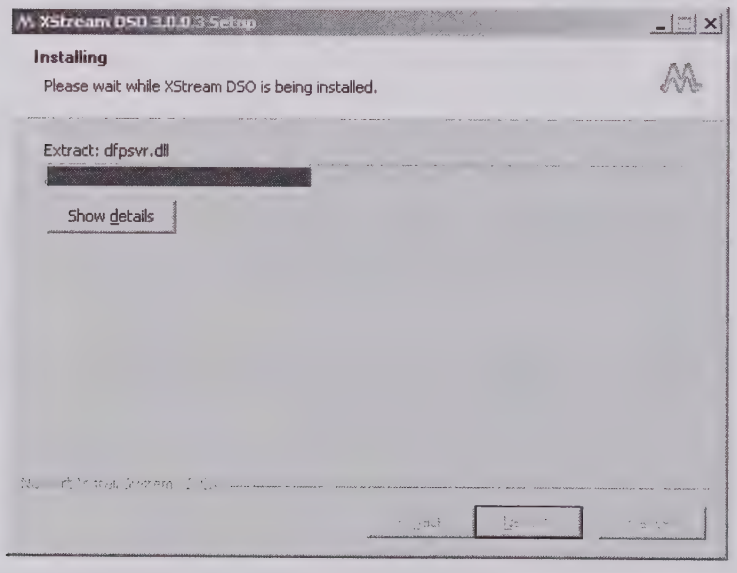
9.5 Assignment. This EULA and the rights and obligations hereunder, may not be assigned, in whole or in part by you, except to a successor to the whole of your business, without the prior written consent of LeCroy. In the case of any permitted assignment or transfer of or under this EULA, this EULA or the relevant provisions will be binding upon, and inure to the benefit of, the successors, executors, heirs, representatives, administrators and assigns of the parties hereto.

9.6 Notices. All notices or other communications between LeCroy and you under this EULA will be in writing and delivered personally, sent by confirmed fax, by confirmed e-mail, by certified mail, postage prepaid and return receipt requested, or by a nationally recognized express delivery service. All notices will be in English and will be effective upon receipt.

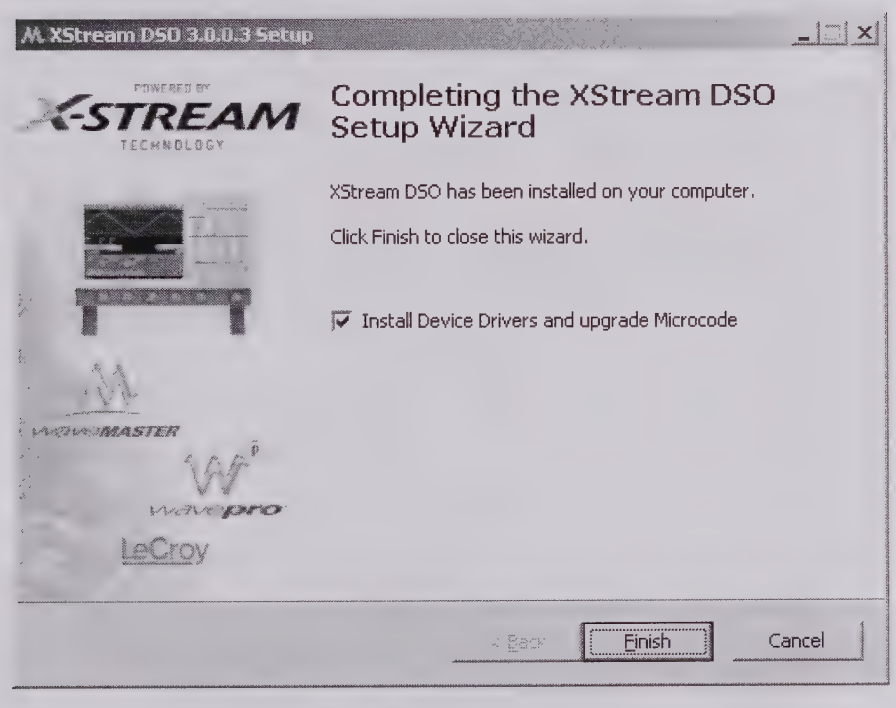
9.7 Headings. The headings used in this EULA are intended for convenience only and will not be deemed to supersede or modify any provisions.

9.8 Acknowledgment. Licensee acknowledges that (a) it has read and understands this EULA, (b) it has had an opportunity to have its legal counsel review this EULA, (c) this EULA has the same force and effect as a signed agreement, and (d) issuance of this EULA does not constitute general publication of the Software Product or other Confidential Information.

- Accept the agreement and press Next. The software installation process will begin and a progress bar will be displayed. Wait until completion.



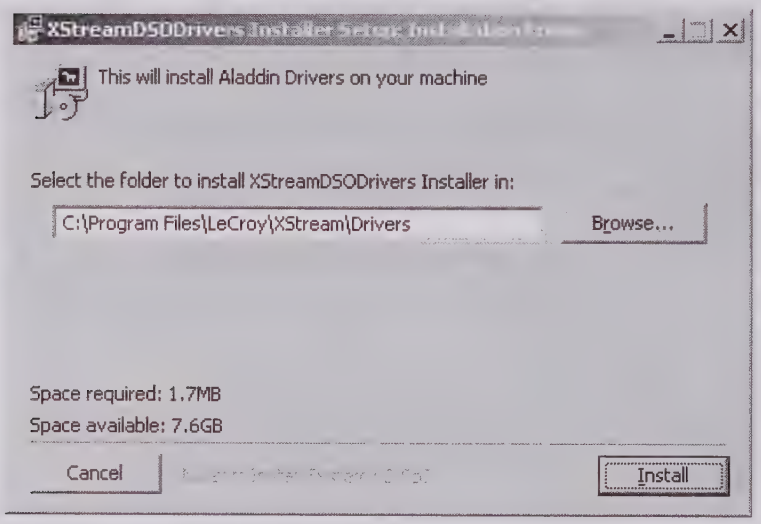
- At the completion on the software installation you will receive a dialog box as shown below:




- The check box should be checked to install the Windows device drivers and to upgrade the Microcode in the instrument.

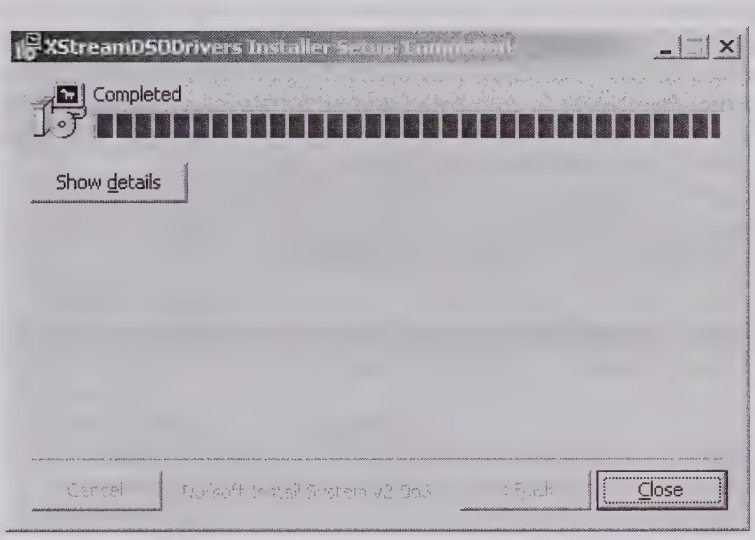
### 6.3.3 Installing Device Drivers

- Pressing finish will first install the device drivers. You will be prompted with a dialog box as shown below:




- Press Install, several new windows will open like shown below, it will take approximately 30 seconds for the drivers to be installed. A Found New Hardware Dialog Box may appear. DO NOT INTERVENE. The installer will automatically close this dialog box after a few seconds and the drivers will be installed.

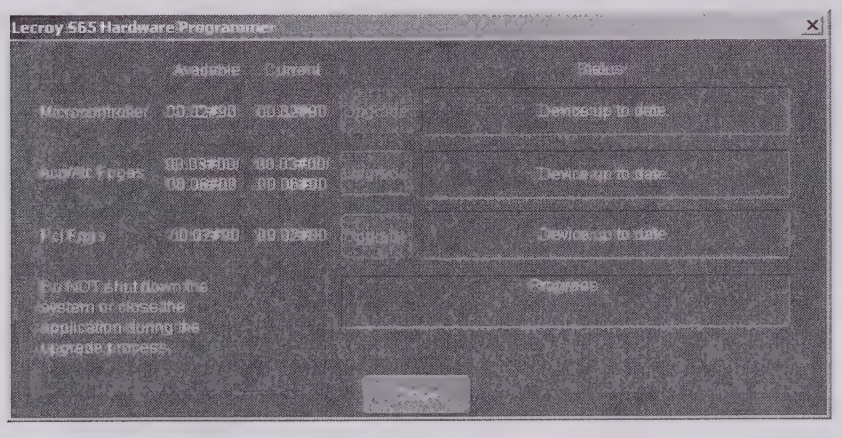
Several found new hardware boxes will momentarily appear, no intervention is required.




- After this is complete press close:

### 6.3.4 Upgrading Microcode

- Next the Hardware Programmer Dialog box will appear:




- If any update is required the update buttons will not be grayed out as shown above. Press one update button and wait for it to complete before pressing any other update buttons. **It is extremely important that this process not be interrupted while the parts are being programmed. Any interruption of power or interruption of the process may require that the instrument be returned to the factory for correction.**

- Once the update process is completed and no errors have been displayed, the power must then be cycled to invoke the new program settings. If no update was required then it is not necessary to cycle the power.
- The XStreamDSO application should automatically begin after power has been restored and after Windows has finished booting up. As the XstreamDSO application is launching the screen will appear as:

### 6.3.5 Verifying Microcode

If the version of the programmed hardware needs to be checked to see if it is at the correct revision for the software which is installed, the WavemasterHardwareProgrammer may be manually invoked by pressing Start, Programs, LeCroy, XStream, Service, hwprogrammer.exe. Follow the instructions list in section 6.3.3 above.

### 6.3.6 Restoring the Operating System

There may be circumstances where it is desired to completely wipe the C: partition of the hard drive and reinstall the operating system and Wavemaster software. Each WaveRunner is supplied with a System Recovery CD which will restore the

original operating system configuration of the instrument. It will not disturb anything which is installed on to the D: drive. Any application software which had been previously installed will need to be reinstalled. The following steps must be followed:

- Plug a keyboard into the instrument.
- Insert the System Recovery CD into the CDROM drive.
- Turn on power to the instrument, the system will boot from the CD (if it does not boot from the CD, the BIOS settings regarding boot order may have been changed, restart the computer while pressing F2 on the keyboard to get to the BIOS settings screen. Change the boot order to boot from the CD first).
- After booting the screen should display the X-Stream System Recovery CD screen.
- Select Continue , press enter
- An additional warning "All C drive data will be lost" appears – press enter for YES
- The software installation progress bars will appear, this loading process will take app. 5 minutes.
- Remove CD when prompted - press enter
- Wait for the operation to take place (10-15 minutes) and an A:\> prompt to appear. (If the message " cannot load the file a:\command.com insert correct disk and strike a key" appears, cycle power on the scope.
- Remove the CD ROM from the drive and cycle power.
- Insert the Wavemaster Installation CD ROM into the drive.
- When the system boots up, Windows 2000 setup will need to be completed before the XStreamDSO Software can be installed onto it Accept the license agreement and press Next.
- You will be prompted for the product key, this can be found on the Windows License label on the rear panel of the instrument.
- When prompted for Computername, type the serial number located on the rear panel (e.g. LCRY0601P63247).
- The unit will finish the setup process.
- At network setup press next.
- When LeCroyuser setup comes up, press next (with a blank password). Press finish.
- Close the add new hardware dialog box.
- Follow directions above for installing new XStreamDSO software.
- Once complete with the XStreamDSO software and driver installation, launch the DSO application.
- Perform the touch screen calibration procedure in step 6.6.2.
- Installation is complete.

### 6.3.7 Software Options

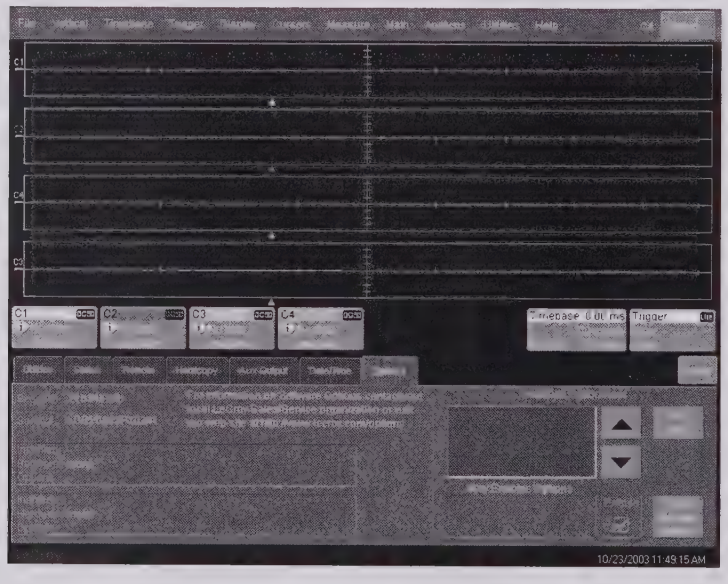
There are many software options available, new ones are being developed all of the time, refer to the LeCroy website for the latest selection of options available.

#### 6.3.7.1 Changing Software Option Key

**a. Scope ID, Scope Serial Number**

The scope ID and scope s/n: are used to request a Software Option Key

- Enter the scope's Software Options menu (located under Utilities, Options)




.Note the **SCOPE ID**, i.e.: 12c5c6-a4 and **Scope s/n**: LCRY0601P10241 that are found on that menu.

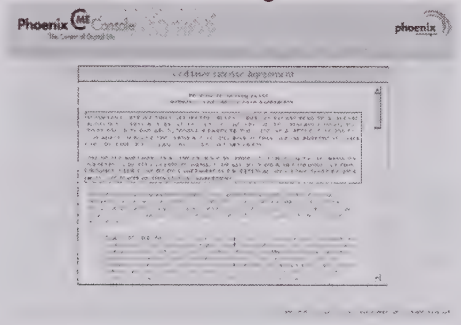
**b. Entering Option Key in the DSO**

- Enter the scope's Software Options menu ( **Utilities, Options** menu ).
- Press the **ADD KEY** button on the DSO touch screen
- Enter the new option key, i.e.: **5F4F-3184-2C81-8EF*8**
- Press **O.K.** to add the key
- Verify that the correct options are enabled (e.g. DDM2, JTA2, XMAP).

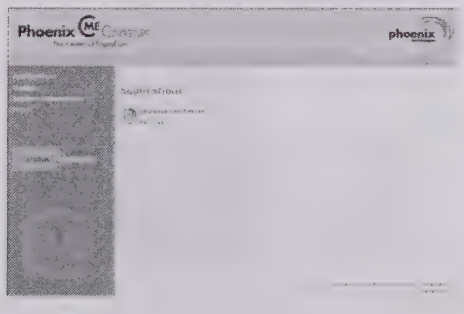
### 6.3.8 Restoring the Operating System

Your WaveRunner Xi Series oscilloscope was designed to operate very reliably for many years. However, the application software does run on an internal hard drive. In the event of a hard disk problem, you may need to recover the application software on drive "C:" and/or the user data on drive "D:". Since WaveRunner Xi Series does not have an installed CD-ROM drive, LeCroy has provided a recovery application program that will allow you to recover the application software and user data by accessing a partition on the hard drive. This is very easy to do, if necessary. Instructions are as follows:

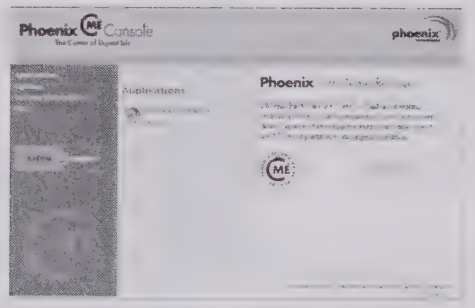
1. Connect a keyboard and a mouse to the WaveRunner Xi Series.
2. Power the WaveRunner Xi Series ON.
3. As soon as anything (logo, graphic, text) appears on the screen after boot-up, press and hold down the **F4** key.
4. The FirstWare cME console splash screen displays. Wait about 10 seconds.
5. The cME console End User License Agreement displays. There are [Accept] and [Decline] buttons at the end of this License Agreement. Click the [Accept] button.




6. Phoenix cME Console main page displays. Click "Applications".
7. Click Phoenix FirstWare Recover. (If you click "SYSTEM RESTART" button, WaveRunner Xi Series will reboot.)




8. Click the LAUNCH button.

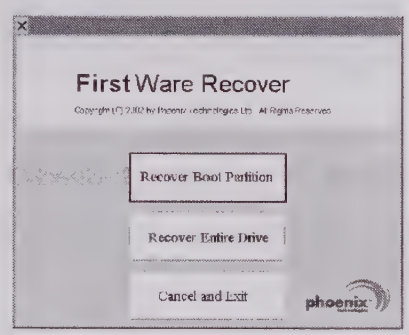



9. The First Ware Recover splash screen displays.

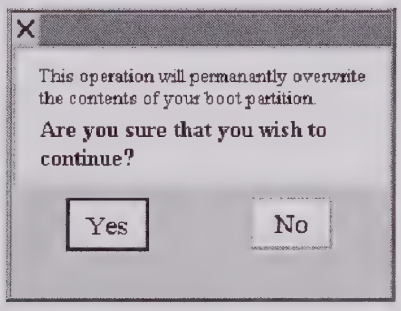
10. Read the license agreement and click [Accept] to proceed.

11. The Select Recover Type screen displays. Select recover option, as defined below:

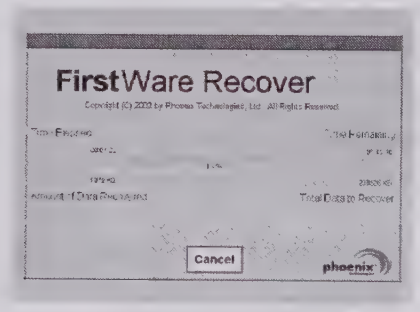
    **[Recover Boot Partition]** Recovers drive "C:" only. Drive "C:" is the drive that the WaveRunner Xi Series application software is stored on. Drive "D:" is not recovered. (Drive "D:" is the USERDATA area of the hard disk.)
    **[Recover Entire Drive]** Select this button if you want to recover both the "C:" and "D:" drives of the hard disk (Note: Any USERDATA will be erased if this option is selected)




12. Read the license agreement and click [Accept] to proceed.
13. The following dialog box will be displayed. Click the [Yes] button.
    - When you select [Recover Boot Partition], the dialog message is "This operation will permanently overwrite the contents of your boot partition. Are you sure that wish to continue?"
    - When you select [Recover Entire Drive], the dialog message is "This operation will permanently overwrite the contents of your entire drive. Are you sure that wish to continue?"


This operation will permanently overwrite the contents of your boot partition.
Are you sure that you wish to continue?
Yes
No

14. The recovery starts, and the FirstWare Progress screen displays. No further selections are required. The recovery takes about 10 minutes.




15. When the recovery is completed, Windows will start automatically. No message or dialog box will display.
16. If you selected [Recover Entire Drive] in step 11, CheckDisk will run after the Windows splash screen.
17. After the "Welcome" screen, the FBReseal dialog box will display. Click the [OK] button. Windows will restart automatically.

## 6.4 Board Exchange Procedure

### 6.4.1 PCI Board Exchange Procedure

The WaveRunner Xi Series uses option keys to identify the correct model number, memory size and software options. These option keys must be re-installed if the PCI board is exchanged..

# 7. Replaceable Parts

To order parts, contact your local LeCroy service office. A list of the service centers is given in section 2 of this manual. For boards, you can either order a new board or an exchange board. Exchange assemblies are factory repaired, inspected, tested and calibrated. If you order an exchange board, you must return the defective board.

This section applies to the following model:

### WaveRunner 64Xi, 44Xi, 42Xi Mechanical & Electrical Replaceable Parts

| Assembly | Description |
|---|---|
| | Scope Mechanical Assembly |
| 913461-00 | 4 CH 600 MHz Acquisition Board |
| 913461-01 | 4 CH 400 MHz Acquisition Board |
| 913791-01 | 2 CH 400 MHz Acquisition Board |
| 913462-00 | 4 CH Front End Board |
| 913792-00 | 2 CH Front End Board |
| 913509-00 | Accessories |
| 903177-00 | VST Board |
| 913315-00 | PCI Interface Board |
| 913408-00 | Front Panel Encoder/Keypad Board |

## 7.1 Scope Mechanical Assy

| Part Number | Qty | Desciption |
|---|---|---|
| 227200013 | 1 | Celeron M processor 1.3 GHz |
| 330000008 | 1 | Hard Drive 40GB 2.5 in |
| 377242002 | 1 | MS XP Pro License |
| 385020180 | 0 | Insulating Film Kapton |
| 519260005 | 1 | Snap-In Open/Closed Bushing ID |
| 554425003 | 19 | Screw S/Tap Phil M2.5X6 Black |
| 563430006 | 35 | Screw TX Pan head M3X0.4-6MM S1 |
| 563430106 | 7 | Screw TX ECO-FIX M3X0.5-6MM S1 |
| 594120003 | 7 | Tiewrap |
| 594120006 | 5 | Tiewrap |
| 770200001 | 1 | Phoenix First Ware Recovery |
| 42258000001 | 1 | DC to AC Inverter |
| 42334040001 | 1 | PC RAM 512MB DIMM |
| 42350480002 | 1 | Gasket EMI Fabric 4mmx4mmx12.5 |
| 42519230002 | 2 | Snap Rivet Nylon |
| 42524105003 | 1 | Standoff 6Hex M/F M3x23 |
| 42524105004 | 2 | Standoff M/F 6Hex M3x15 |
| 42550000004 | 6 | Screw Pan head HD Torx M3x22 w/patc |
| 42551130100 | 4 | Washer Flat M3 9mm OD |
| 42555507001 | 2 | Screw Self Tap Phil # 6-19 x 1 |
| 42575000001 | 8 | Washer Silicone 2mm Thick |
| 42592060001 | 2 | 3.0 Inch Cable Assy 50-Pos Rev |
| 42771020001 | 1 | Stylus Plastic - Palm M100 |
| 901582-01 | 7 | Knob Small |
| 901583-01 | 3 | Knob Medium |
| 901584-02 | 2 | Knob Large |
| 901887-00 | 1 | Oscilloscope Backbone Licence |
| 903118-00 | 1 | Touchscreen Display Assembly |
| 903177-00 | 1 | VST PCA |
| 913212-00 | 1 | System Power Supply |
| 913315-00 | 1 | PCI to Acq Interface Card |
| 913321-00 | 1 | Backlight Cable Assembl |
| 913322-00 | 1 | LCD Cable Assembly |
| 913323-00 | 1 | USB Cable Assembly |
| 913324-00 | 1 | Trigger / Ready and Tri |
| 913325-00 | 1 | PCMB Encoder Cable Asse |
| 913326-00 | 1 | Power Switch Cable Asse |
| 913330-00 | 1 | Chassis Assy |
| 913331-01 | 1 | Back Shell |
| 913333-00 | 1 | I/O Plate |
| 913334-00 | 1 | Acqusition Support Plate |
| 913335-00 | 1 | PCI Support Bracket |
| 913337-00 | 2 | Foot Base |
| 913338-00 | 2 | Foot - Flipper |

## Scope Mechanical Assy (continued)

| Part Number | Qty | Desciption |
|---|---|---|
| 913343-00 | 1 | PC Motherboard MX855-LC |
| 913347-00 | 1 | Front Frame |
| 913369-00 | 1 | Backlight Inverter Shie |
| 913373-00 | 1 | Hard Drive Cable Assemb |
| 913395-00 | 1 | Rubber Keymat |
| 913408-00 | 1 | Front Pan headel PCA |
| 913460-00 | 1 | 500 MHz/4ch Acq. System |
| 913461-00 | 1 | 500 MHz/4ch Acq Mechanical Assy |
| 913462-00 | 1 | 500 MHz/4ch Front End Mechanical Assy |
| 913498-00 | 1 | FP EMI Shield |
| 913500-00 | 1 | Bezel |
| 913509-00 | 1 | Accessories - 4ch R |
| 913514-00 | 1 | MB I/O Label |
| 913515-00 | 1 | CPU Cooler |
| 913521-01 | 1 | Handle Assy |
| 913530-00 | 1 | Power Supply Hood |
| 913531-00 | 1 | Shipping Package |
| 913569-00 | 1 | Front Pan headel Overlay |
| 913574-00 | 1 | Model Name Overlay |
| 913575-00 | 1 | Channel Number Overlay |
| 913576-00 | 1 | Input Rating Overlay |
| 913585-00 | 12 | Machine Screw M3 Flat Undercut |
| 913585-00 | 3 | Machine Screw M3 Flat Undercut |
| 913590-00 | 2 | Foot Spring |
| 913608-00 | 2 | 70 mm Fan Assembly |
| 913662-00 | 1 | Label - Serial Number printed |

## 7.2 913461-00 – Acquisition Board Mechanical Assy

| Part Number | Qty | Desciption |
|---|---|---|
| 550010120 | 4 | Screw Pan Head Phil M3X20 W/NY |
| 563430006 | 4 | SCREW TX PAN M3X0.4-6MM S1 |
| 709614330 | 4 | HFE428 Heatsink |
| 709614331 | 4 | HFE428 Heatsink Clip |
| 42507000001 | 1 | Heatsink S02GZZ0J 50mm SQ. |
| 42507000002 | 2 | Heatsink Assembly 70x70x40mm |
| 902528-00 | 6 | Thermal Gap Pad Die-Cut |
| 913346-00 | 1 | Fan Tray |
| 913450-00 | 1 | MTT Coax Cable Assembly |
| 913451-00 | 1 | ADC1 Coax Cable Assembl |
| 913452-00 | 1 | ADC2 Coax Cable Assembl |
| 913582-00 | 1 | Acquisition Board PCA |
| 913608-00 | 1 | 70 mm Fan Assembly |
| CH599041022 | 1 | Heat Sink Compound 251 |

## 7.3 913462-00 – Front End Board Mechanical Assy

| Part Number | Qty | Desciption |
|---|---|---|
| 469040002 | 1 | Metal Banana Jack/Binding Post |
| 554425003 | 10 | Screw S/Tap Phil M2.5X6 Black |
| 555465002 | 1 | Washer Lock Split 1/4 |
| 563430006 | 24 | SCREW TX PAN M3X0.4-6MM S1 |
| 709614301 | 5 | BNC Lock Washer |
| 709614302 | 5 | BNC Nut |
| 42350480001 | 1 | Gasket EMI Fabric 3x3mmx12.6in |
| 42544220001 | 1 | Spring Compression .31 in L |
| 42550000003 | 18 | Screw Pan HD Torx m3x10 w/pa |
| 7093XXP41 | 5 | Probe Holder |
| 7093XXP91 | 5 | Probe Ring Contact |
| 913327-00 | 1 | Main Card Panel |
| 913354-00 | 1 | Power Button |
| 913374-00 | 1 | Front End EMI Shield Top |
| 913378-00 | 1 | Front End EMI Shield Bottom |
| 913379-00 | 6 | Front End EMI Rib Top |
| 913380-00 | 5 | Front End EMI Rib Bottom |
| 913405-00 | 5 | Relay Shield |
| 913570-00 | 1 | EMI Rib Bottom Ext |
| 913578-00 | 1 | Main Card Panel Overlay |
| 913597-00 | 1 | FE PCA |

## 7.4 Accessories

| Part Number | Qty | Desciption |
|---|---|---|
| 771000001 | 1 | Optical Wheel Mouse |
| 901477-00 | 1 | LeCroy Blue Cal Void Sticker |
| 901963-00 | 1 | Ethernet Security Label |
| 902006-00 | 1 | LeCroy DSO Security Certificat |
| 913746-00 | 1 | WRXI CECERT |
| CALIB-DE1 | 1 | Calibration Document Envelope |
| GENCARD | 1 | REGISTRATION CARDS |
| GENCORD | 1 | POWERCORDS FROM ACC BOMS |
| PP008-2 | 2 | Dual Pack Probe |

## 7.5 903177-00 – VST Board Electrical Parts

| Part Number | Qty | Desciption |
|---|---|---|
| 42SM207010001 | 1 | IC LVDS FlatLink Receiver |
| 42SM301001001 | 2 | Ferrite Bead 60 Ohms 3A |
| 42SM453020001 | 1 | Conn PanelMate Hdr R/A 20-Pos |
| 42SM453041001 | 1 | Conn Recept Vert 41-Pos 1mm |
| 42SM655031000 | 1 | Res Thk Flm 1% 0 Ohm 1.0A |
| 42SM655031097 | 5 | Res Thk Film 1% 100 Ohm 1/10W |
| 42SM662237102 | 6 | Cap Cera 20% 25V 0.1uF X7R |
| 42SM662247101 | 8 | Cap Cera 20% 50V .01uF X7R |
| 42SM662617101 | 2 | Cap Cera 20% 10V 10uF X7R |
| 913455-00 | 1 | VST PCB |
| SM468969001 | 1 | Test Point .150X.040X.090 |

## 7.6 913315-00 – PCI to ACQ Interface Board Electrical Parts

| Part Number | Qty | Desciption |
|---|---|---|
| 530040006 | 1 | Buzzer 85DB 4 TO 7V |
| 42454120002 | 1 | Conn PC104 Socket Vert 120-Pos |
| 42455910001 | 1 | Conn PC104 Shroud Vert 120-Pos |
| 42SM454050001 | 2 | Conn Ejector Hdr Vert 50-Pos |
| 42SM655031258 | 7 | Res Thk Film 1% 4.75K Ohm 1/10 |
| 913559-00 | 1 | Hornet PCI Card PCB |
| SM205108433 | 1 | IC Eeprom 4K Bit W/ Serial Num |
| SM205717001 | 1 | IC PAL PQ208 Plastic QFP |
| SM208540002 | 1 | IC Adj Pos Volt Reg 3A LDO |
| SM236020050 | 1 | Diode Rectifier 50V 1A |
| SM280120138 | 1 | N Channel Pwr Mosfet BSS138LT |
| SM311200125 | 1 | Gigabit Crystal Osc. 125Mhz |
| SM652061000 | 9 | Res Chip 0 Ohm Jumper |
| SM652061103 | 1 | Res Chip 1% 10K Ohm .063W |
| SM652061221 | 15 | Res Chip 1% 220 Ohm .063W |
| SM652061240 | 1 | Res Chip 1% 24.0 Ohm .063W |
| SM652061301 | 1 | Res Chip 1% 300 Ohm .063W |
| SM655030037 | 47 | Res Thk Film 1% 121 Ohm 1/16W |
| SM655030041 | 1 | Res Thk Film 1% 53.6 Ohm 1/16W |
| SM661068104 | 43 | Cap Cera Chip 0.1uF 0603 |
| SM662232001 | 1 | 10000pf 0603 capacitor |
| SM666086022 | 4 | Cap Mold Tant Chip 22 UF |

## 7.7 913408-00 – Front Panel Encoder/Keypad Board Electrical Parts

| Part Number | Qty | Desciption |
|---|---|---|
| 42425100001 | 2 | Encoder 20mm Detent |
| 42425100002 | 2 | Encoder 20mm Detent JOG |
| 42425100003 | 8 | Encoder 20mm Detent JOG PB |
| 42SM202101001 | 1 | IC Quad 2-In NAND Gate VHC00DR |
| 42SM202101002 | 1 | IC Hex CMOS Inverter 74VHC04D |
| 42SM205035001 | 1 | CPLD XC9572XL-10 10NS Delay |
| 42SM208500001 | 1 | Linear CMOS Reg 300mA LP3982 |
| 42SM208500002 | 1 | IC Reset TPS3809K33 |
| 42SM227030002 | 1 | IC USB 2.0 HUB Controller |
| 42SM227039001 | 1 | IC 16-Bit Microcomputer USB |
| 42SM230000001 | 19 | Diode Triple Switching BAS16VY |
| 42SM256000001 | 1 | Diode LED SP Red 2mm |
| 42SM256000003 | 1 | Diode LED SP Yellow 2mm |
| 42SM256000004 | 14 | Diode LED Aqua Green 2mm |
| 42SM256000005 | 1 | Diode LED SP Blue 2mm |
| 42SM270090001 | 5 | Transistor NPN BRT MUN5211T1G |
| 42SM275000001 | 5 | Transistor PNP BRT MUN5111T1G |
| 42SM301001001 | 2 | Ferrite Bead 60 Ohms 3A |
| 42SM310900001 | 1 | Crystal 24 MHz FPXLF |
| 42SM453003003 | 1 | Conn Hdr Vert 3-Pos Shrouded |
| 42SM453004001 | 1 | Conn FFC-FPC R/A 7-Pos ZIF |
| 42SM453005003 | 2 | Conn Hdr Vert 5-Pos Shrded 1.5 |
| 42SM453006002 | 1 | Conn Hdr Vert 6-Pos Shrouded |
| 42SM453014001 | 1 | Conn Hdr Vert 14-Pos Shrouded |
| 42SM453020001 | 1 | Conn PanelMate Hdr R/A 20-Pos |
| 42SM453020002 | 1 | Conn Hdr Vert 20-Pos 1.25mm |
| 42SM655031038 | 3 | Res Thk Film 1% 24.3 Ohm 1/10W |
| 42SM655031101 | 5 | Res Thk Film 1% 110 Ohm 1/10W |
| 42SM655031147 | 13 | Res Thk Film 1% 332 Ohm 1/10W |
| 42SM655031164 | 4 | Res Thk Film 1% 499 Ohm 1/10W |
| 42SM655031193 | 3 | Res Thk Film 1% 1K Ohm 1/10W |
| 42SM655031258 | 12 | Res Thk Film 1% 4.75K Ohm 1/10 |
| 42SM655031297 | 47 | Res Thk Flm 1% 12.1K Ohm 1/10W |
| 42SM655031322 | 8 | Res Thk Flm 1% 22.1K Ohm 1/10W |
| 42SM655031385 | 8 | Res Thk Film 1% 100K Ohm 1/10W |
| 42SM662117102 | 20 | Cap Cera 20% 10V 0.1uF X7R |
| 42SM662127101 | 12 | Cap Cera 20% 16V .01uF X7R |
| 42SM662135001 | 2 | Cap Cera 5% 25V 10pF NPO |
| 42SM662617101 | 5 | Cap Cera 20% 10V 10uF X7R |
| 42SM662637101 | 2 | Cap Cera 20% 25V 2.2uF X7R |
| 913407-00 | 1 | Front Panel PCB |
| SM468969001 | 2 | Test Point .150X.040X.090 |

## 7.8 913582-00 – Acquisition Board Electrical Parts

| Part Number | Qty | Desciption |
|---|---|---|
| 454000018 | 1 | Hdr Sold Tail Male 18 Pin HI T |
| 454016002 | 1 | Conn Hdr Vert 16 Pos Wire-BD |
| 454022001 | 1 | HEADER VERT 22 POS WIRE BD |
| 42554430100 | 8 | Standoff Press-Fit M3x3mm |
| 42594200001 | 2 | Heatsink Clip Solder Anchor |
| 42SM145433001 | 2 | Cap Alum Elec 20% 1000uF/25V |
| 42SM202021001 | 3 | IC Dual Retrig Mono/Multivib |
| 42SM202024001 | 1 | IC Hex Schmitt-Trig Inv 74HC14 |
| 42SM205021001 | 1 | IC 256K X 16 Async SRAM 55ns |
| 42SM205036001 | 1 | IC FPGA XC3S100E-VQ100 |
| 42SM206007001 | 7 | IC Quad Bus Buffer w/3-State |
| 42SM206088001 | 5 | IC CMOS Hi-Spd Analog Mux/DeMu |
| 42SM206090002 | 2 | IC SMBus PWM Fan Speed Control |
| 42SM208450001 | 1 | IC Voltage Ref 4.096V 5ppm |
| 42SM208500002 | 1 | IC Reset TPS3809K33 |
| 42SM270130001 | 2 | Transistor NPN MMBT2222ALT1G |
| 42SM301001007 | 13 | Ferrite Bead 220 Ohm 2A |
| 42SM301001011 | 3 | Inductor Power SMT 5.6uH 4A |
| 42SM311000003 | 1 | Crystal Osc XO 10MHz Y1600 |
| 42SM453002002 | 2 | Conn Hdr Vert 2-Pos Shrouded |
| 42SM453003003 | 1 | Conn Hdr Vert 3-Pos Shrouded |
| 42SM453005003 | 1 | Conn Hdr Vert 5-Pos Shrded 1.5 |
| 42SM453006002 | 1 | Conn Hdr Vert 6-Pos Shrouded |
| 42SM454050001 | 2 | Conn Ejector Hdr Vert 50-Pos |
| 42SM454050002 | 5 | Conn Hi-Spd Socket Vert 50-Pos |
| 42SM655021000 | 14 | Res Thk Film 1% 0 Ohm 1.0A |
| 42SM655021105 | 66 | Res Thk Film 1% 121 Ohm 1/16W |
| 42SM655021120 | 4 | Res Thk Film 1% 174 Ohm 1/16W |
| 42SM655021130 | 50 | Res Thk Film 1% 221 Ohm 1/16W |
| 42SM655021154 | 7 | Res Thk Flm 1% 392 Ohm 1/16W |
| 42SM655021193 | 9 | Res Thk Flm 1% 1K Ohm 1/16W |
| 42SM655021200 | 16 | Res Thk Flm 1% 1.18K Ohm 1/16W |
| 42SM655021222 | 7 | Res Thk Flm 1% 2K Ohm 1/16W |
| 42SM655021261 | 8 | Res Thk Flm 1% 5.11K Ohm 1/16W |
| 42SM655021277 | 8 | Res Thk Flm 1% 7.5K Ohm 1/16W |
| 42SM655021289 | 10 | Res Thk Film 1% 10K Ohm 1/16W |
| 42SM655031000 | 3 | Res Thk Flm 1% 0 Ohm 1.0A |
| 42SM655031062 | 7 | Res Thk Flm 1% 43.2 Ohm 1/10W |
| 42SM655031077 | 8 | Res Thk Film 1% 61.9 Ohm 1/10W |
| 42SM655031097 | 16 | Res Thk Film 1% 100 Ohm 1/10W |
| 42SM655031126 | 1 | Res Thk Flm 1% 200 Ohm 1/10W |
| 42SM655031181 | 1 | Res Thk Flm 1% 750 Ohm 1/10W |
| 42SM655031193 | 21 | Res Thk Film 1% 1K Ohm 1/10W |
| 42SM655031222 | 38 | Res Thk Flm 1% 2K Ohm 1/10W |

## 913582-00 – Acquisition Board Electrical Parts (continued)

| Part Number | Qty | Desciption |
|---|---|---|
| 42SM655031239 | 7 | Res Thk Flm 1% 3.01K Ohm 1/10W |
| 42SM655031243 | 5 | Res Thk Flm 1% 3.32K Ohm 1/10W |
| 42SM655031251 | 3 | Res Thk Flm 1% 4.02K Ohm 1/10W |
| 42SM655031289 | 40 | Res Thk Film 1% 10K Ohm 1/10W |
| 42SM655031300 | 4 | Res Thk Flm 1% 13K Ohm 1/10W |
| 42SM655031318 | 17 | Res Thk Flm 1% 20K Ohm 1/10W |
| 42SM655031357 | 3 | Res Thk Film 1% 51.1K Ohm 1/10 |
| 42SM655031365 | 5 | Res Thk Flm 1% 61.9K Ohm 1/10W |
| 42SM655033001 | 7 | Res Thk Film 5% 0.33 Ohm 1/10W |
| 42SM655041147 | 3 | Res Thk Film 1% 332 Ohm 1/8W |
| 42SM655041154 | 19 | Res Thk Film 1% 392 Ohm 1/8W |
| 42SM662117102 | 45 | Cap Cera 20% 10V 0.1uF X7R |
| 42SM662145001 | 28 | Cap Cera 5% 50V 390pF C0G |
| 42SM662237102 | 93 | Cap Cera 20% 25V 0.1uF X7R |
| 42SM662247101 | 10 | Cap Cera 20% 50V .01uF X7R |
| 42SM662317101 | 6 | Cap Cera 20% 10V 1.0uF X7R |
| 42SM662617101 | 39 | Cap Cera 20% 10V 10uF X7R |
| 913411-00 | 3 | Hornet Clock EMI Shield |
| 913435-00 | 1 | Hornet Main Acq Card PCB |
| HAD639C-02 | 2 | Packaged MAD440E 10GS/s SiGe |
| HFE444 | 4 | Hybrid Dso Front End 1GHZ |
| HTT660 | 1 | Trigger and Timebase |
| MAM439 | 6 | Monolithic 8 Megabyte Dram Mem |
| SM185457201 | 1 | Res Vari Cermet 200 Ohms |
| SM200178074 | 1 | IC D-Typ Flop 74HCT74 |
| SM200180032 | 1 | IC 2-in OR Gate 74VHC1G32 |
| SM201174011 | 2 | IC Ecl 1:2 Diff Clock Drvr 10E |
| SM201570016 | 1 | IC Ecl Diff Receiver 10EL16D |
| SM201774025 | 1 | Diff Ecl-Ttl Transl 10ELT25 |
| SM202100004 | 1 | IC PLL Freq Synth 4106 6 GHz |
| SM205129160 | 1 | IC FLASH MEM 16 MBIT HY29LV160 |
| SM205200002 | 1 | IC 8M x 8 Bit 133MHz SDRAM |
| SM205715003 | 1 | IC PAL FG456 Fine-Pitch BGA |
| SM206370024 | 3 | IC Ttl TO Diff Ecl Transl MC10 |
| SM207010002 | 1 | IC CMOS 8 BIT LOW RES BUS SWIT |
| SM207010011 | 1 | IC Quad 10-Bit DAC LTC1664 |
| SM207010014 | 1 | 16 Bit Buffer/Driver 3-State |
| SM207010029 | 1 | IC 16-Bit Octal DAC R/R LTC260 |
| SM208400001 | 3 | IC MMIC Amplifier 12GHz NBB-30 |
| SM208400002 | 1 | IC MMIC Amplifier 8GHz NBB-400 |
| SM208470353 | 8 | IC Dual OP Amp LF353 |
| SM208472022 | 2 | Opamp Dual Low Pwr TLE2022C |
| SM208476482 | 2 | IC Dual OP Amp Rail TO Rail 64 |
| SM208550004 | 7 | IC Volt Reg Pos Adjust LDO |
| SM208701023 | 1 | IC Temperature Sensor |

## 913582-00 – Acquisition Board Electrical Parts (continued)

| Part Number | Qty | Desciption |
|---|---|---|
| SM208870339 | 1 | IC Volt Comparator 339 |
| SM208909850 | 1 | DDS-125MHZ Cmos Synth AD9850 |
| SM227110161 | 1 | 16 BIT MICROCONTROLLER C161PI |
| SM232022824 | 1 | Diode Array Schottky HSMS2824 |
| SM236030099 | 2 | Diode SO-Pkg BAV99 |
| SM256232013 | 1 | Diode Light Emitting Red |
| SM270130092 | 4 | Transistor Npn BFR92A |
| SM270330848 | 3 | Transistor Npn BC848C |
| SM275132907 | 2 | Transistor Pnp 2907A |
| SM281115003 | 3 | P-CH Hdtmos Pwr E-Fet MTB50P03 |
| SM300092390 | 1 | Inductor Wound 2% 39 NH |
| SM300295082 | 16 | Inductor 8.2 NH 5% |
| SM300600009 | 2 | Inductor 9.3uH 7.2A Wound |
| SM300600012 | 2 | Inductor 150nH 5% Wound |
| SM301001001 | 18 | BEAD FERRITE |
| SM301001002 | 6 | Bead SHF 0.3A |
| SM301001016 | 4 | Inductor Pwr Toroid 272uH .36A |
| SM301001017 | 3 | Inductor Chip 10% 15uH 1210 |
| SM301001018 | 1 | Inductor Shielded 100uH 10% |
| SM301004001 | 18 | Bead Ferrite 50 Ohms 3AMPS 120 |
| SM311000005 | 1 | Crystal Oscillator 16 MHz 3.3V |
| SM311000006 | 1 | Voltage Controlled Oscillator |
| SM468969001 | 10 | Test Point .150X.040X.090 |
| SM507000002 | 2 | Heatsink Surface Mount TO-263 |
| SM651081102 | 6 | Res Chip 0.1% 1 Kohm |
| SM652041000 | 2 | Res Zero ohms |
| SM652041011 | 24 | Res Chip 1% 49.9 Ohms |
| SM652041200 | 18 | Res 20 Ohms +/-1% 1/16W 0402 S |
| SM652061100 | 2 | Res Chip 1% 10.0 Ohm .063W |
| SM652061101 | 2 | Res Chip 1% 100 Ohm .063W |
| SM652061102 | 10 | Res Chip 1% 1.0K Ohm .063W |
| SM652061105 | 1 | Res Chip 1% 1.0M Ohm .063W |
| SM652061200 | 1 | Res Chip 1% 20.0 Ohm .063W |
| SM652061221 | 2 | Res Chip 1% 220 Ohm .063W |
| SM652061222 | 1 | Res Chip 1% 2.2K Ohm .063W |
| SM652061240 | 1 | Res Chip 1% 24.0 Ohm .063W |
| SM652061271 | 2 | Res Chip 1% 270 Ohm .063W |
| SM652061271 | 1 | Res Chip 1% 270 Ohm .063W |
| SM652061332 | 7 | Res Chip 1% 3.3K Ohm .063W |
| SM652061334 | 1 | Res Chip 1% 330K Ohm .063W |
| SM652061393 | 1 | Res Chip 1% 39K Ohm .063W |
| SM652061510 | 12 | Res Chip 1% 51.0 Ohm .063W |
| SM652061511 | 2 | Res Chip 1% 510 Ohm .063W |
| SM653101226 | 1 | Res Chip 1% 18.2 Ohms |

## 913582-00 – Acquisition Board Electrical Parts (continued)

| Part Number | Qty | Desciption |
|---|---|---|
| SM653101285 | 7 | Res Chip 1 % 75.0 Ohms |
| SM653101297 | 9 | Res Chip 1% 100 Ohms |
| SM653101322 | 2 | Res Chip 1% 182 Ohms |
| SM653101326 | 7 | Res Chip 1% 200 Ohms |
| SM653101334 | 6 | Res Chip 1% 243 Ohms |
| SM653101377 | 5 | Res Chip 1% 681 Ohms |
| SM653101393 | 7 | Res Chip 1% 1.00 K |
| SM653101401 | 3 | Res Chip 1% 1.21 K |
| SM653101410 | 13 | Res Chip 1% 1.50 K |
| SM653101422 | 6 | Res Chip 1% 2.00 K |
| SM653101426 | 3 | Res Chip 1 % 2.21K |
| SM653101458 | 6 | Res Chip 1 % 4.75 K |
| SM653101461 | 1 | Res Chip 1% 5.11 K |
| SM653101489 | 9 | Res Chip 1 % 10.0 K |
| SM653101539 | 4 | Res Chip 1% 33.2 K |
| SM653125047 | 9 | Res Thick Film 5% 4.7 Ohms |
| SM654101000 | 11 | Chip Jumper Zero Ohms |
| SM655020025 | 16 | Res Thk Film 1% 2.74 Ohm 1/16W |
| SM655080004 | 1 | Res Thk Film 1 Ohm +/- 5% 1/2W |
| SM655080005 | 8 | Res Thk Film 1% 105 Ohm 1/2W |
| SM661010002 | 14 | Cap Cera Chip 27PF +/- 5% |
| SM661045150 | 4 | Cap 15PF +/-5% 50V Smt Npo 040 |
| SM661066102 | 16 | Cap Cera Chip 10% 1000PF/50V |
| SM661068104 | 16 | Cap Cera Chip 0.1uF 0603 |
| SM661073331 | 3 | Cap Cera 330PF+/- 5% 50V Npo |
| SM661073820 | 7 | Cap Cera 82PF+/- 5% 50V Npo |
| SM661165102 | 3 | Cap Cera Chip 1000PF |
| SM661207103 | 3 | Cap Cera Chip 20% .01 UF |
| SM661207104 | 145 | Cap Cera Chip 20 % .1 UF |
| SM661255015 | 1 | Cap Cera Chip 1.5 PF |
| SM661255121 | 2 | Cap Cera Chip 5% 120 PF |
| SM662111002 | 78 | Cap Cera Chip 1000pF 5% 25V |
| SM662135002 | 16 | Cap Cera +/-.1pF 50V 1.0pF NPO |
| SM662137004 | 8 | Cap Cera +/-.25% 50V 3.3pF NPO |
| SM662151001 | 12 | Cap Cera Chip 10% 16V 0.1 UF |
| SM662152001 | 16 | Cap Cera Chip 10% 16V 100nF |
| SM662232001 | 8 | 10000pf 0603 capacitor |
| SM662432001 | 1 | Cap Cera 4700pF 10% 50V X7R |
| SM662432002 | 1 | Cap Cera Chip 0.22uF 10% 50V |
| SM662913001 | 53 | Cap Cera Chip 10uF 20% 25V X5R |
| SM666267227 | 22 | Cap Tant 220UF 10V 20% |
| SM669117001 | 16 | Inductor Chip 2.2uH 20% 350mA |

## 7.9 913597-00 – Front End Board Electrical Parts

| Part Number | Qty | Desciption |
|---|---|---|
| 416162005 | 1 | Switch R/A PCB Mtg SPDT MOM |
| 454004002 | 1 | Conn Receptacle USB R/A 4 Pos |
| 42405100001 | 1 | PC Screw Terminal M3 |
| 42SM158022001 | 9 | Cap Variable-Trimmer 4 - 25 pF |
| 42SM158022002 | 5 | Cap Variable-Trimmer 1.4-3 pF |
| 42SM158022003 | 4 | Cap Variable-Trimmer 2 - 6 pF |
| 42SM180094001 | 4 | IC Trimming Pot 200 Ohm |
| 42SM180193002 | 4 | IC Trimming Pot 5K Ohm ST4EA |
| 42SM192413001 | 10 | Thermal Sensor 1% 2K Ohm 1/32W |
| 42SM192439001 | 4 | Thermistor NTC 5% 220 Ohm |
| 42SM202026001 | 1 | IC CMOS 2-Ch Mux/Demux TC4W53F |
| 42SM202060001 | 5 | IC 2-Input OR Gate 74HCT1G32 |
| 42SM205024001 | 10 | IC 8-Bit Shift Reg 3-State 74H |
| 42SM208240001 | 1 | IC Dual Op Amp TA75S558F |
| 42SM230000001 | 33 | Diode Triple Switching BAS16VY |
| 42SM230500001 | 5 | Diode Switching HSM124S |
| 42SM230900001 | 33 | Diode Hi-Speed Switching 1SS35 |
| 42SM230900002 | 1 | Diode Hi-Speed Switching 1SS26 |
| 42SM240710001 | 5 | Diode Zener 4.7V RD4.7S |
| 42SM270690002 | 5 | Transistor NPN 2SC4228 |
| 42SM270690003 | 10 | Transistor NPN 2SC4227 R34 |
| 42SM270990001 | 5 | Transistor NPN 2SC3583 R34 |
| 42SM275000001 | 5 | Transistor PNP BRT MUN5111T1G |
| 42SM275690002 | 15 | Transistor PNP 2SA1586 |
| 42SM280000002 | 5 | Transistor JFET N-Ch 2SK508-K5 |
| 42SM289210001 | 9 | Transistor NPN/PNP PIMD3 |
| 42SM289210002 | 44 | Transistor NPN/PNP UMZ1N |
| 42SM289318001 | 4 | Transistor HJ-FET N-Ch NE34018 |
| 42SM301001001 | 6 | Ferrite Bead 60 Ohms 3A |
| 42SM301001002 | 4 | Inductor Chip 10nH 5% |
| 42SM301001003 | 4 | Inductor Chip 12nH 5% |
| 42SM301001004 | 5 | Inductor Chip 15nH 5% |
| 42SM301001006 | 1 | Inductor Chip 8.2nH 5% |
| 42SM301001007 | 25 | Ferrite Bead 220 Ohm 2A |
| 42SM301001008 | 91 | Ferrite Bead 600 Ohm 100mA |
| 42SM430920003 | 5 | Relay 2-Contact 1A 4.5V G6K-2F |
| 42SM430920004 | 26 | Relay 2-Contact 1A 4.5V G6KU-2 |
| 42SM453005003 | 1 | Conn Hdr Vert 5-Pos Shrded 1.5 |
| 42SM453050001 | 5 | Conn Hdr R/A 50-Pos 0.635mm |
| 42SM655021289 | 88 | Res Thk Film 1% 10K Ohm 1/16W |
| 42SM655031000 | 20 | Res Thk Flm 1% 0 Ohm 1.0A |
| 42SM655031001 | 4 | Res Thk Film 1% 10 Ohm 1/10W |
| 42SM655031034 | 9 | Res Thk Film 1% 22.1 Ohm 1/10W |
| 42SM655031038 | 5 | Res Thk Film 1% 24.3 Ohm 1/10W |

## 913597-00 – Front End Board Electrical Parts (continued)

| Part Number | Qty | Desciption |
|---|---|---|
| 42SM655031042 | 1 | Res Thk Film 1% 26.7 Ohm 1/10W |
| 42SM655031047 | 4 | Res Thk Film 1% 30.1 Ohm 1/10W |
| 42SM655031051 | 20 | Res Thk Film 1% 33.2 Ohm 1/10W |
| 42SM655031066 | 6 | Res Thk Film 1% 47.5 Ohm 1/10W |
| 42SM655031069 | 10 | Res Thk Film 1% 51.1 Ohm 1/10W |
| 42SM655031077 | 5 | Res Thk Film 1% 61.9 Ohm 1/10W |
| 42SM655031081 | 1 | Res Thk Film 1% 68.1 Ohm 1/10W |
| 42SM655031085 | 8 | Res Thk Film 1% 75 Ohm 1/10W |
| 42SM655031097 | 26 | Res Thk Film 1% 100 Ohm 1/10W |
| 42SM655031105 | 9 | Res Thk Film 1% 121 Ohm 1/10W |
| 42SM655031108 | 9 | Res Thk Film 1% 130 Ohm 1/10W |
| 42SM655031114 | 5 | Res Thk Film 1% 150 Ohm 1/10W |
| 42SM655031122 | 8 | Res Thk Film 1% 182 Ohm 1/10W |
| 42SM655031126 | 2 | Res Thk Flm 1% 200 Ohm 1/10W |
| 42SM655031130 | 9 | Res Thk Film 1% 221 Ohm 1/10W |
| 42SM655031143 | 4 | Res Thk Film 1% 301 Ohm 1/10W |
| 42SM655031147 | 8 | Res Thk Film 1% 332 Ohm 1/10W |
| 42SM655031154 | 11 | Res Thk Film 1% 392 Ohm 1/10W |
| 42SM655031158 | 5 | Res Thk Film 1% 432 Ohm 1/10W |
| 42SM655031162 | 4 | Res Thk Film 1% 475 Ohm 1/10W |
| 42SM655031177 | 5 | Res Thk Film 1% 681 Ohm 1/10W |
| 42SM655031193 | 35 | Res Thk Film 1% 1K Ohm 1/10W |
| 42SM655031197 | 9 | Res Thk Film 1% 1.1K Ohm 1/10W |
| 42SM655031204 | 4 | Res Thk Film 1% 1.3K Ohm 1/10W |
| 42SM655031210 | 1 | Res Thk Film 1% 1.5K Ohm 1/10W |
| 42SM655031213 | 6 | Res Thk Film 1% 1.62K Ohm 1/10 |
| 42SM655031218 | 5 | Res Thk Flm 1% 1.82K Ohm 1/10W |
| 42SM655031222 | 5 | Res Thk Flm 1% 2K Ohm 1/10W |
| 42SM655031226 | 7 | Res Thk Flm 1% 2.21K Ohm 1/10W |
| 42SM655031234 | 2 | Res Thk Flm 1% 2.67K Ohm 1/10W |
| 42SM655031235 | 1 | Res Thk Flm 1% 2.74K Ohm 1/10W |
| 42SM655031239 | 1 | Res Thk Flm 1% 3.01K Ohm 1/10W |
| 42SM655031250 | 5 | Res Thk Flm 1% 3.92K Ohm 1/10W |
| 42SM655031277 | 10 | Res Thk Film 1% 7.5K Ohm 1/10W |
| 42SM655031289 | 18 | Res Thk Film 1% 10K Ohm 1/10W |
| 42SM655031314 | 1 | Res Thk Flm 1% 18.2K Ohm 1/10W |
| 42SM655031335 | 5 | Res Thk Film 1% 30.1K Ohm 1/10 |
| 42SM655031357 | 9 | Res Thk Film 1% 51.1K Ohm 1/10 |
| 42SM655031381 | 8 | Res Thk Film 1% 90.9K Ohm 1/10 |
| 42SM655031385 | 24 | Res Thk Film 1% 100K Ohm 1/10W |
| 42SM655031393 | 6 | Res Thk Film 1% 121K Ohm 1/10W |
| 42SM655031422 | 4 | Res Thk Film 1% 243K Ohm 1/10W |
| 42SM655031561 | 5 | Res Thk Film 1% 6.81M Ohm 1/10 |
| 42SM655040001 | 50 | Res Thn Film 0.5% 20 Ohm 1/10W |
| 42SM655040002 | 9 | Res Thn Flm 0.1% 110K Ohm 1/10 |

## 913597-00 – Front End Board Electrical Parts (continued)

| Part Number | Qty | Desciption |
|---|---|---|
| 42SM655040003 | 1 | Res Thn Flm 0.1% 200K Ohm 1/10 |
| 42SM655040003 | 18 | Res Thn Flm 0.1% 200K Ohm 1/10 |
| 42SM655040004 | 29 | Res Thn Flm 0.1% 300K Ohm 1/10 |
| 42SM655040005 | 4 | Res Thn Flm 0.1% 430K Ohm 1/10 |
| 42SM655040006 | 4 | Res Thn Flm 0.1% 470K Ohm 1/10 |
| 42SM662117102 | 1 | Cap Cera 20% 10V 0.1uF X7R |
| 42SM662225001 | 10 | Cap Cera 5% 16V 100pF NPO |
| 42SM662226201 | 13 | Cap Cera 10% 16V 1.0uF X5R |
| 42SM662237102 | 93 | Cap Cera 20% 25V 0.1uF X7R |
| 42SM662246001 | 5 | Cap Cera 10% 50V .033uF X7R |
| 42SM662247101 | 60 | Cap Cera 20% 50V .01uF X7R |
| 42SM662575001 | 5 | Cap Cera 5% 500V 27pF NPO |
| 42SM662579001 | 5 | Cap Cera +/-.25pF 500V 1pF NPO |
| 42SM662579901 | 5 | Cap Cera +/-.25pF 500V 5.0pF C |
| 42SM662592101 | 4 | Cap Cera 10% 250V 4700pF X7R |
| 42SM662599101 | 5 | Cap Cera 15% 630V 2200pF X7R |
| 42SM662617101 | 3 | Cap Cera 20% 10V 10uF X7R |
| 7093XXP01 | 5 | Right Angle Recept. Connector |
| 7093XXP21 | 5 | Bulkhead Receptacle Female Bnc |
| 913586-00 | 1 | Cal Probe Hook |
| 913589-00 | 1 | Hornet FE PCB |
| SM202057002 | 1 | IC Triple 2-CH Analog Mux |
| SM207944351 | 1 | OCTAL ANALOG MUX/DEMUX 74HCT43 |
| SM208470353 | 4 | IC Dual OP Amp LF353 |
| SM208470705 | 6 | IC OP Amp Picoamp Input AD705 |
| SM208472022 | 1 | Opamp Dual Low Pwr TLE2022C |
| SM468969001 | 10 | Test Point .150X.040X.090 |
| SM652061103 | 1 | Res Chip 1% 10K Ohm .063W |
| SM653101322 | 4 | Res Chip 1% 182 Ohms |
| SM661066102 | 85 | Cap Cera Chip 10% 1000PF/50V |
| SM661073005 | 4 | Cap Cera 0.5+/- 0.1PF 50V Npo |
| SM661073010 | 9 | Cap Cera 1.0 +/-0.1PF 50V Npo |
| SM661073020 | 16 | Cap Cera 2.0+/- 0.1PF 50V Npo |
| SM661073030 | 4 | Cap Cera 3.0+/- 0.1PF 50V Npo |
| SM661073039 | 10 | Cap Cera 3.9+/- 0.1PF 50V Npo |
| SM661073051 | 4 | Cap Cera 5.1+/- 0.1PF 50V Npo |
| SM661073062 | 9 | Cap Cera 6.2+/- 0.1PF 50V Npo |
| SM661073270 | 4 | Cap Cera 27PF+/- 5% 50V Npo |
| SM661207104 | 1 | Cap Cera Chip 20 % .1 UF |
| SM662230002 | 1 | Capacitor 1.5PF+/-0.05PF 50V |
| SM662913001 | 10 | Cap Cera Chip 10uF 20% 25V X5R |

# 8. Mechanical Parts

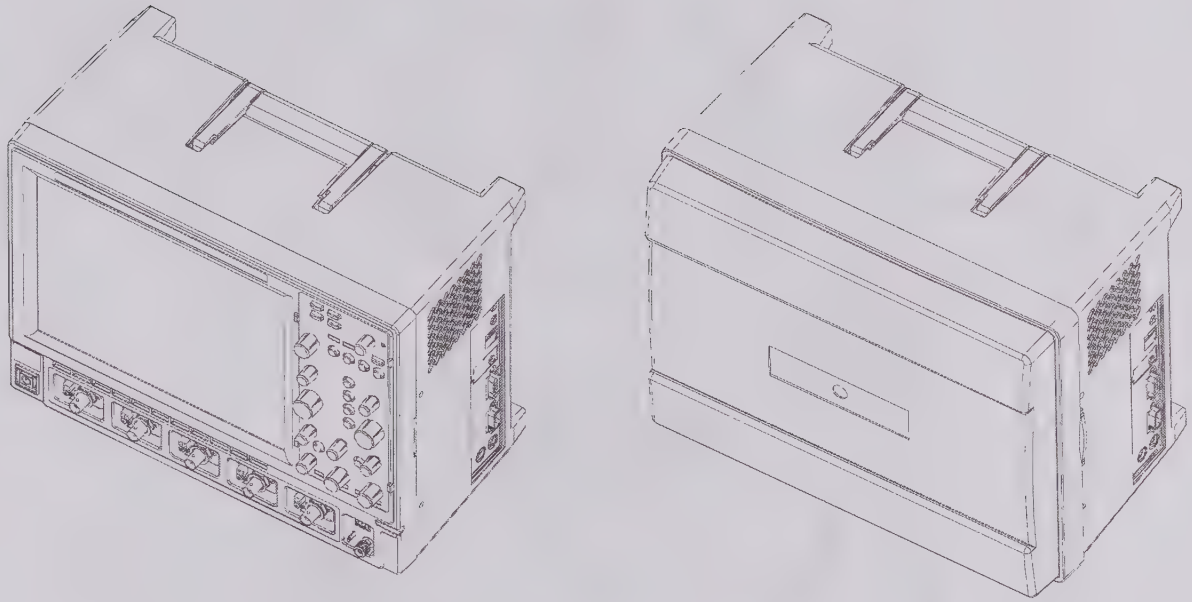


**Figure 8-1 WaveRunner Xi Scope**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| | 913832-00 | 1 | WaveRunner 44Xi Model Name Overlay |
| | 913574-00 | 1 | WaveRunner 64Xi Model Name Overlay |
| | 913729-00 | 1 | WaveRunner 62Xi Model Name Overlay |
| | 913563-00 | 1 | WaveRunner Xi Protective Front Cover |

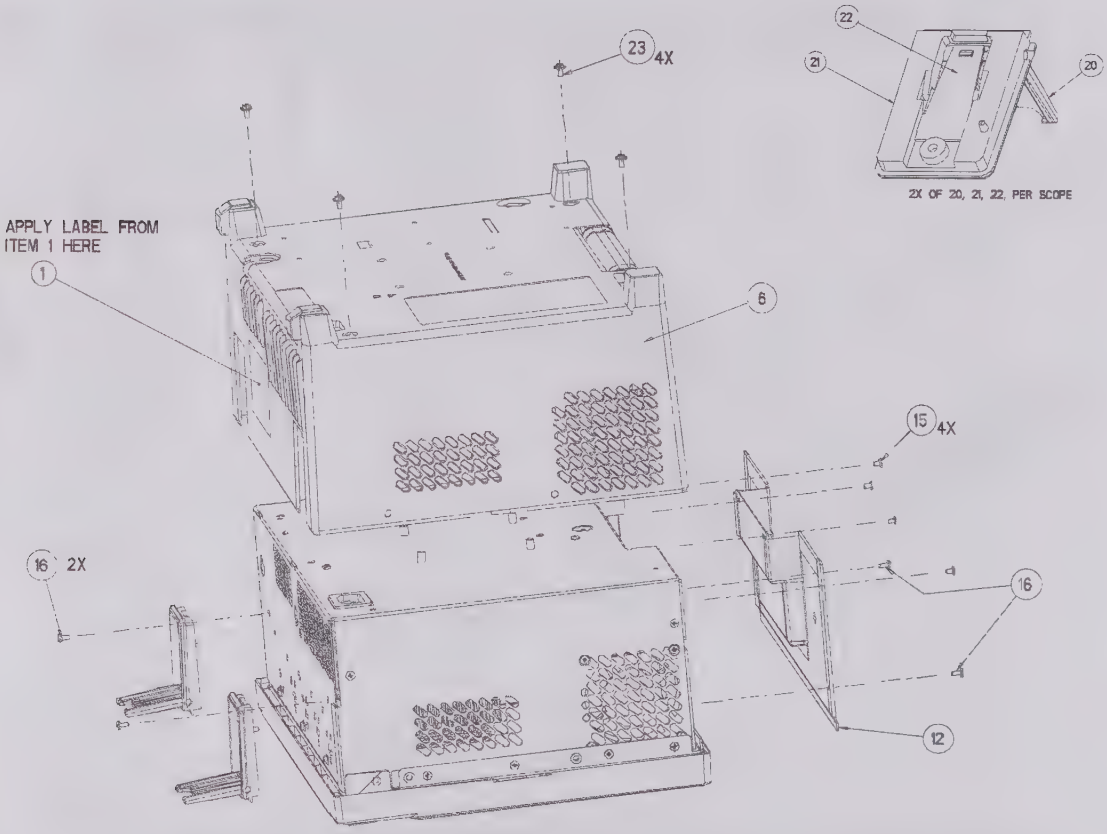



**Figure 8-2 Installation of Back Shell**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 1 | 377242002 | 1 | MS XP Pro License |
| 12 | 913336-00 | 1 | Box Top Assy |
| 15 | 913585-00 | 4 | Machine Screw M3 Flat Undercut |
| 16 | 563430006 | 4 | Screw TX PAN M3X0.4-6MM S1 |
| 20 | 913338-00 | 2 | Foot - Flipper |
| 21 | 913337-00 | 2 | Foot Base |
| 22 | 913590-00 | 2 | Foot Spring |
| 23 | 563430106 | 4 | Screw TX ECO-FIX M3X0.5-6MM S1 |

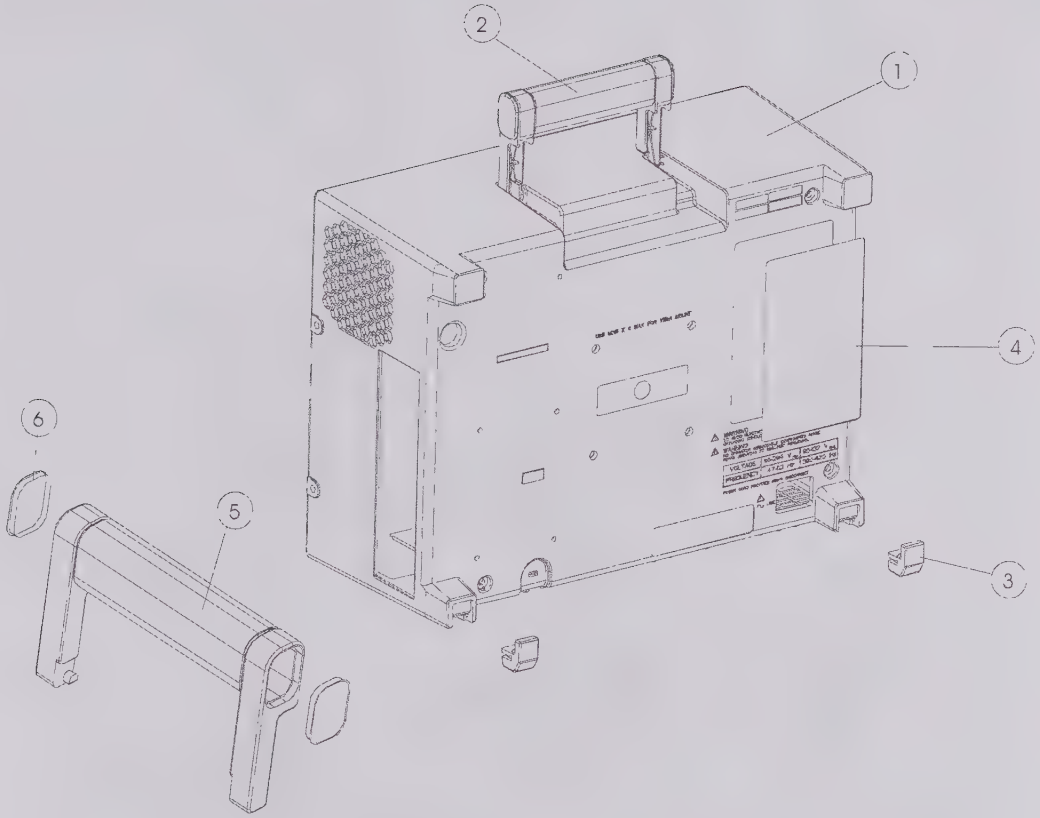



**Figure 8-3 Back Shell Assembly**

| Item | Part Number | Qty | Desciption |
|---|---|---|---|
| 1 | 913331-01 | 1 | WRXi Back Cover |
| 2 | 913521-01 | 1 | WRXi Handle Assy |
| 3 | 913339-00 | 2 | Rear Foot |
| 4 | 913922-00 | 1 | Serial Number Label |
| 5* | 913520-01 | 1 | WRXi Handle |
| 6* | 913341-01 | 2 | Handle Cap Blue |
| 7* | 42CH599010003 | 0 | Loctite 409 Instant Adhesive |

* part of item 2

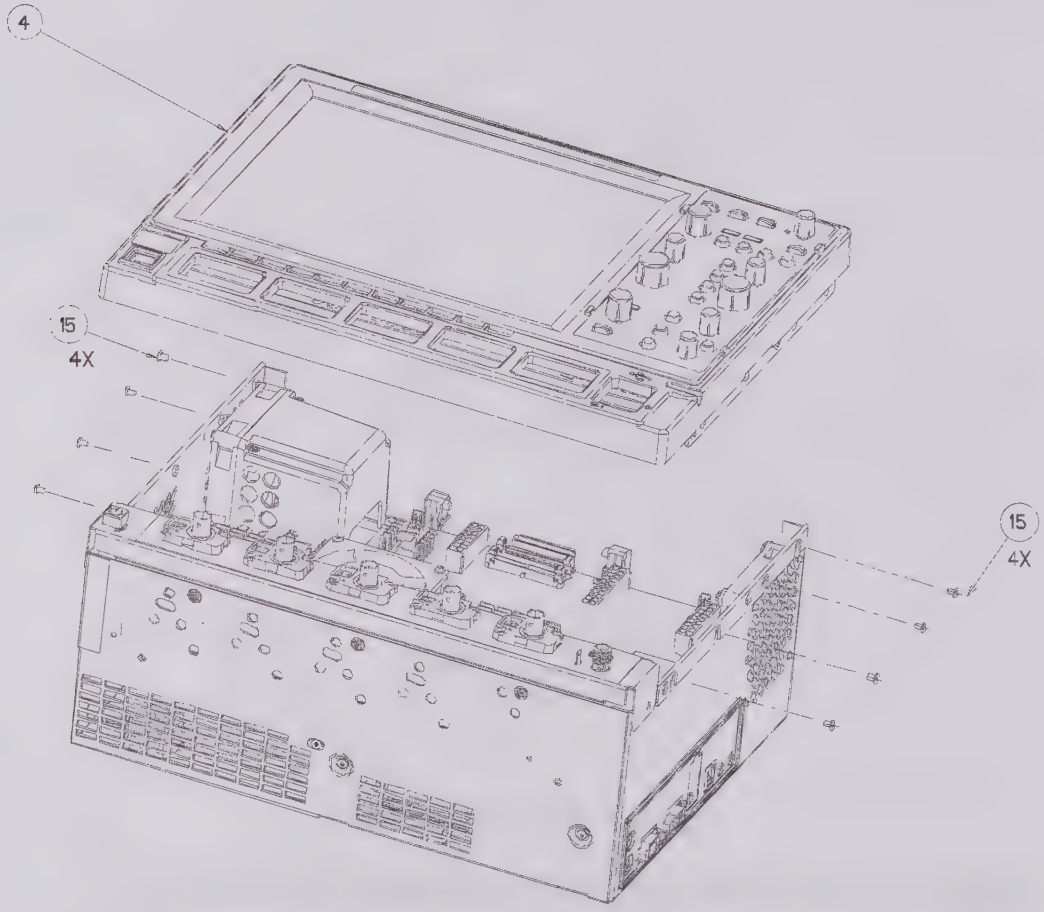



**Figure 8-4 Installation of Front Frame**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 4 | See Figure 8-6 – 8-10 | 1 | Front Box Assy |
| 15 | 913585-00 | 8 | Machine Screw M3 Flat Undercut |

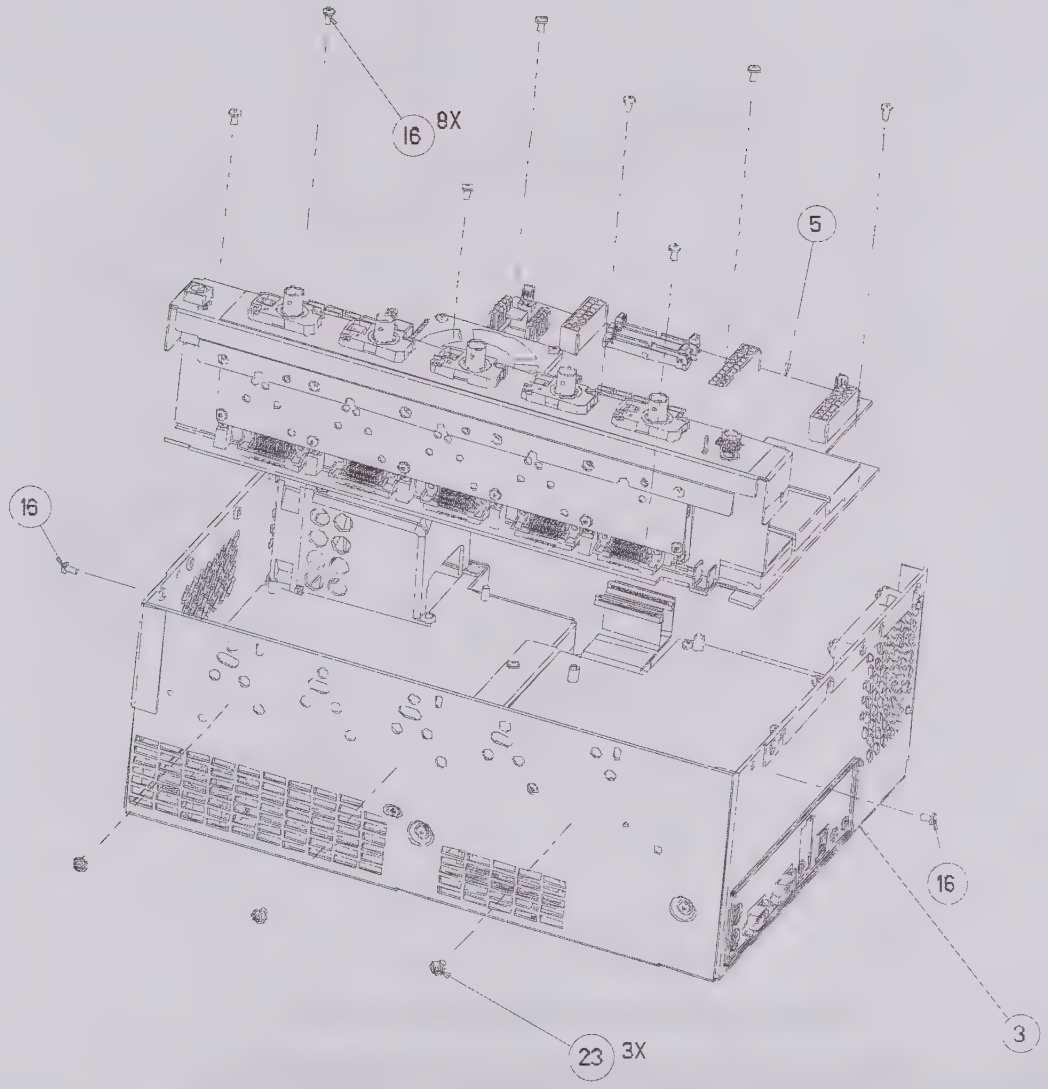



**Figure 8-5 Installation of Acquisition System**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 3 | See Figure 8-11 – 8-17 | 1 | Back Box Assy |
| 5 | See Figure 8-18 | 1 | 500 MHz/4ch Acq. System |
| 16 | 563430006 | 9 | Screw TX PAN M3X0.4-6MM S1 |
| 23 | 563430106 | 7 | Screw TX ECO-FIX M3X0.5-6MM S1 |

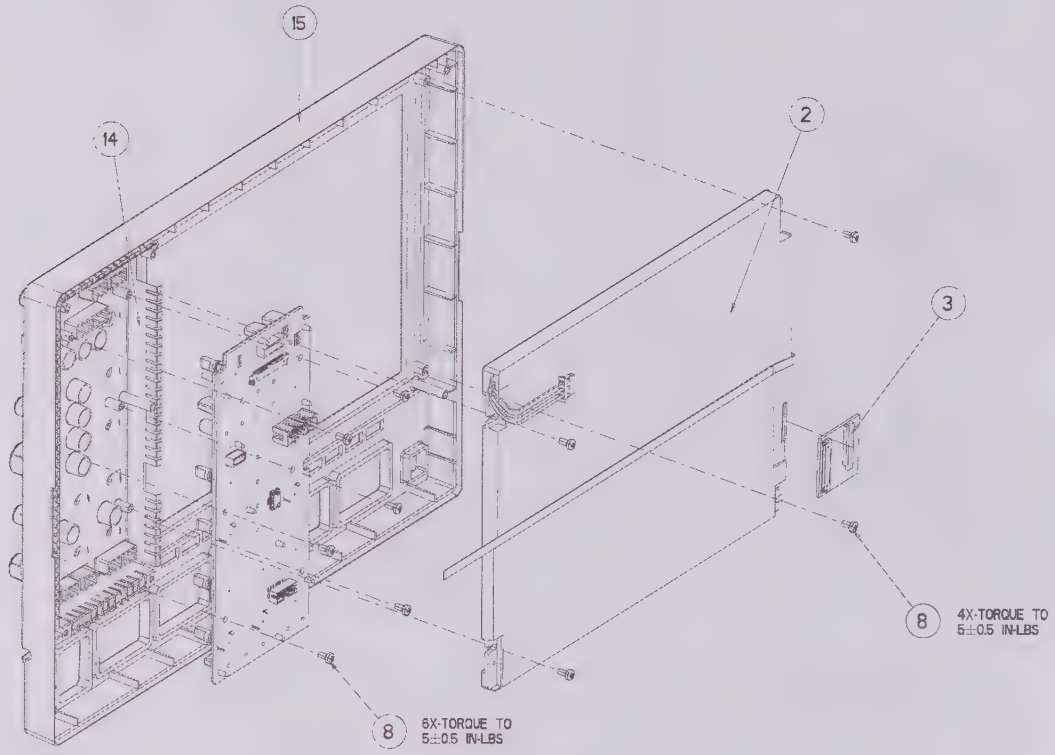



**Figure 8-8 Installation of Encoder & TFT to Bezel**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 2 | 903118-00 | 1 | Touchscreen Display Assembly |
| 3 | 903177-00 | 1 | VST PCA |
| 8 | 554430003 | 9 | Screw S/Tap Phil M3x6 |
| 14 | 913498-00 | 1 | FP EMI Shield |
| 15 | 913500-00 | 1 | Bezel |

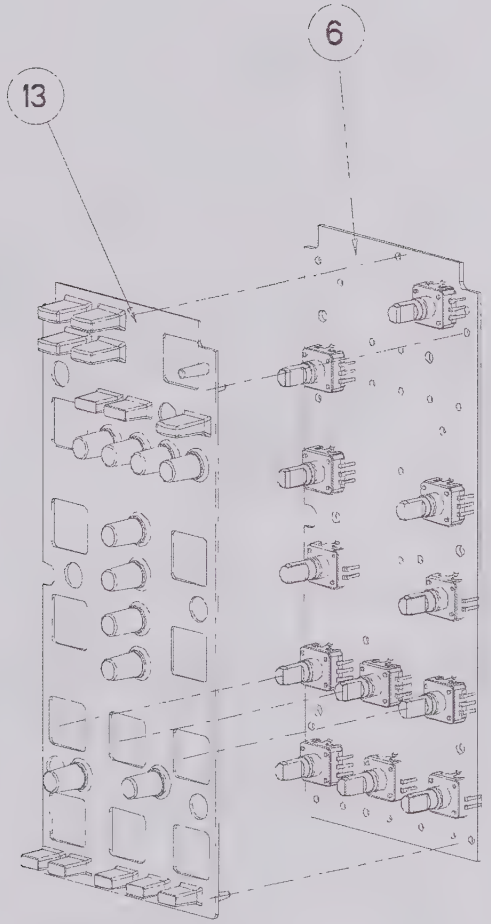



**Figure 8-9 Elastomeric Keypad to Encoder Board**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 6 | 913408-00 | 1 | Front Panel PCA |
| 13 | 913395-00 | 1 | Rubber Keymat |

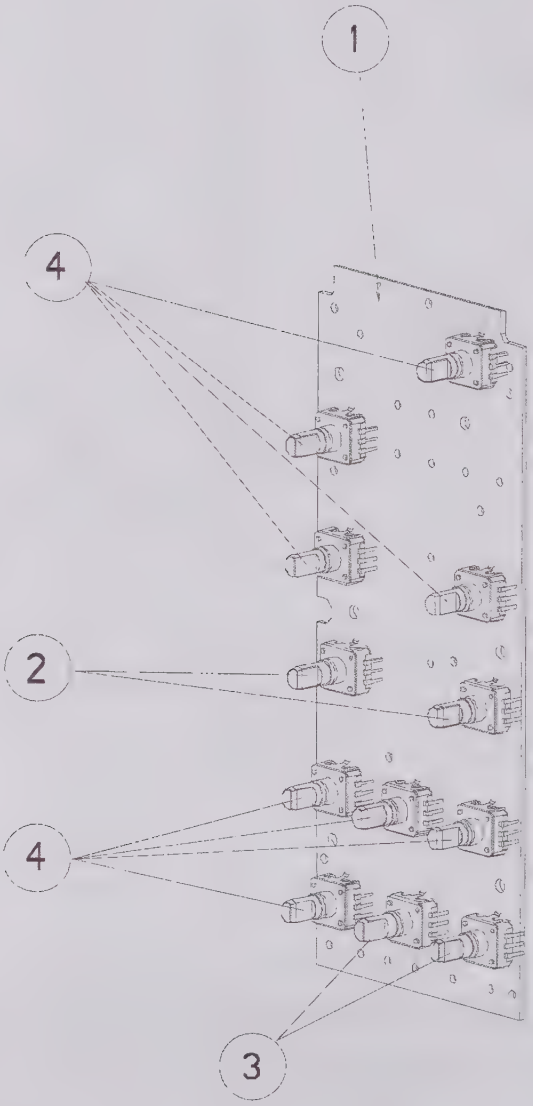



**Figure 8-10 Encoders**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 1 | 913408-00 | 1 | Front Panel Encoder Board/Keypad |
| 2 | 42425100001 | 2 | Encoder 20mm Detent |
| 3 | 42425100002 | 2 | Encoder 20mm Detent JOG |
| 4 | 42425100003 | 8 | Encoder 20mm Detent JOG PB |

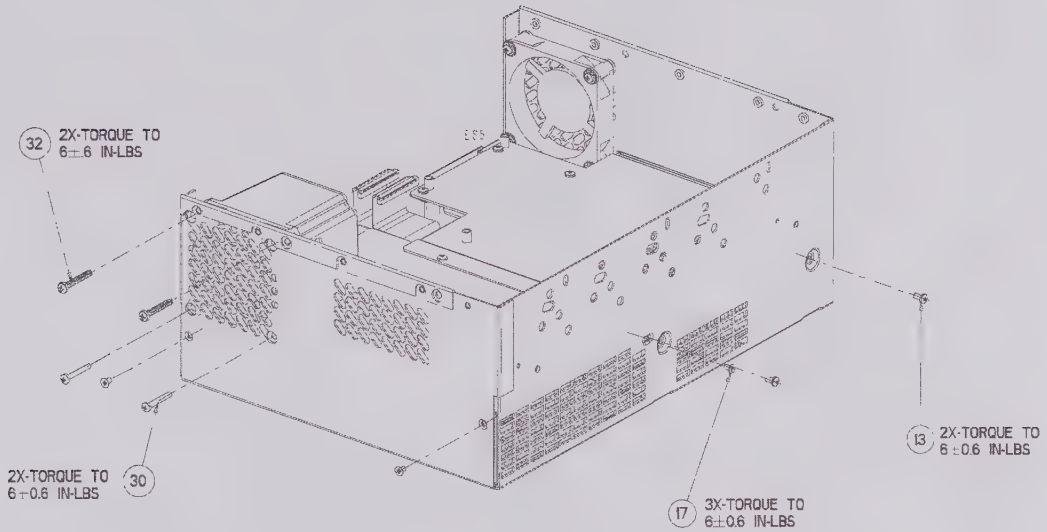
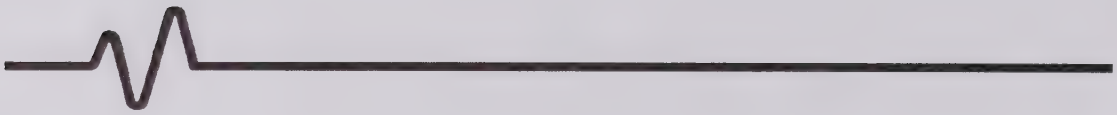



**Figure 8-11 Installation of Power Supply Hood**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 13 | 563430006 | 2 | Screw TX PAN M3X0.4-6MM S1 |
| 17 | 913585-00 | 3 | Machine Screw M3 Flat Undercut |
| 30 | 42550000004 | 2 | Screw pan HD Torx M3x22 w/patc |
| 32 | 42555507001 | 2 | Screw Self Tap Phil # 6-19 x 1 |



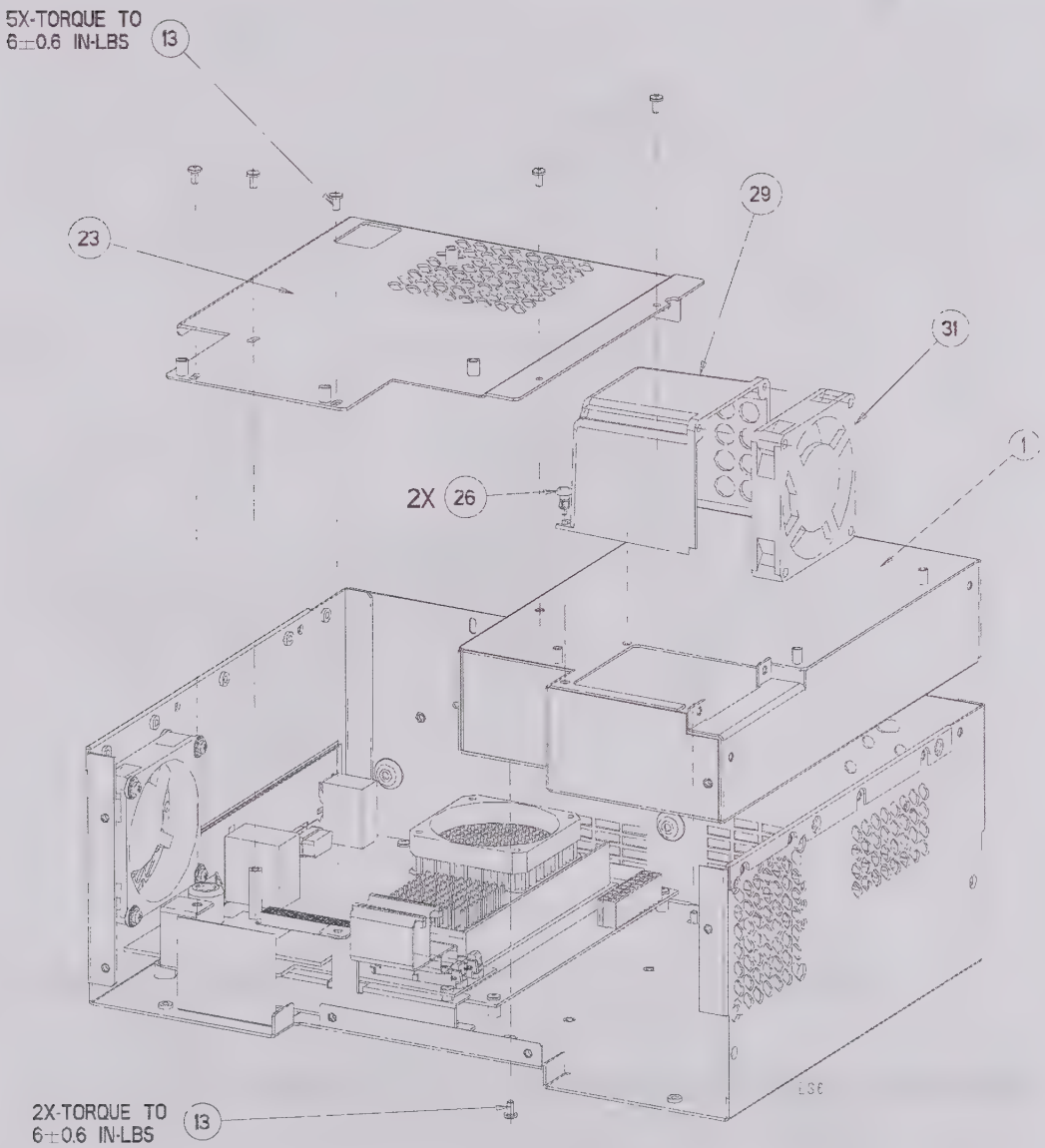



**Figure 8-12 Installation of Power Supply to Chassis**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 1 | 913212-00 | 1 | System Power Supply |
| 13 | 563430006 | 7 | Screw TX PAN M3X0.4-6MM S1 |
| 23 | 913334-00 | 1 | Acquisition Support Plate |
| 26 | 42519230002 | 2 | Snap Rivet Nylon |
| 29 | 913530-00 | 1 | Power Supply Hood |
| 31 | 913608-00 | 1 | 70 mm Fan Assembly |

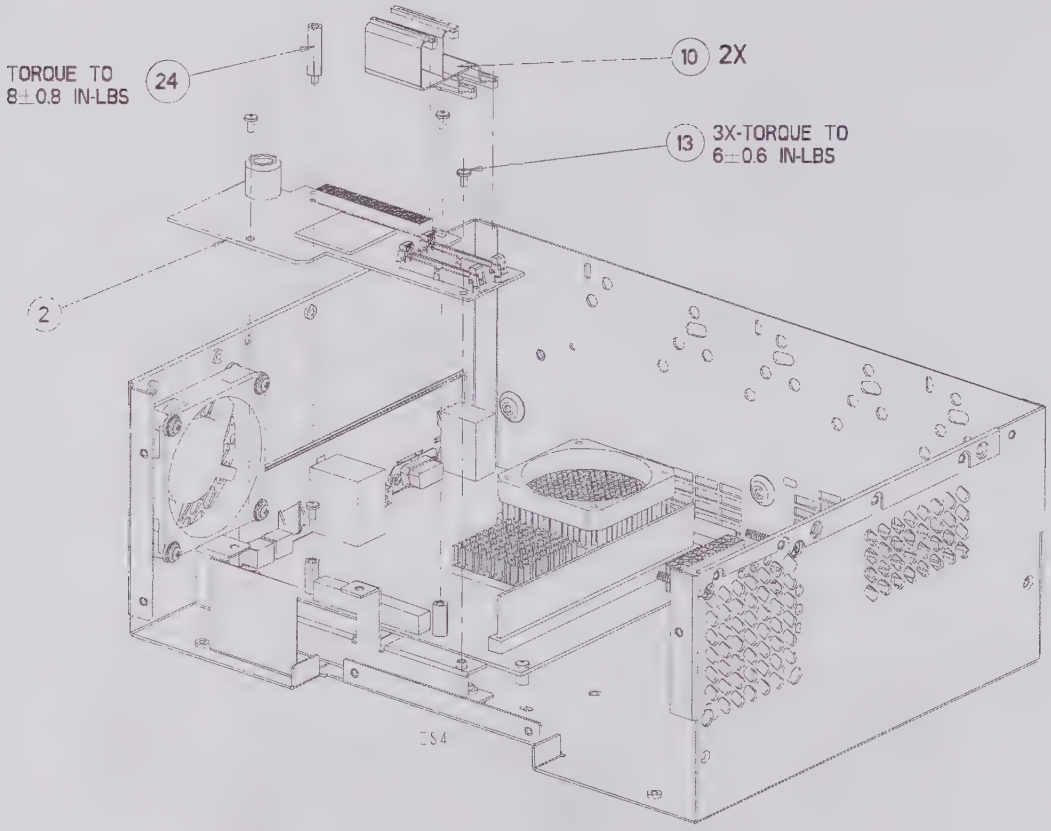



**Figure 8-13 Installation of PCI card**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 2 | 913315-00 | 1 | PCI to Acq Interface Card |
| 10 | 42592060001 | 2 | 3.0 Inch Cable Assy 50-Pos Rev |
| 13 | 563430006 | 3 | Screw TX PAN M3X0.4-6MM S1 |
| 24 | 42524105003 | 1 | Standoff 6Hex M/F M3x23 |

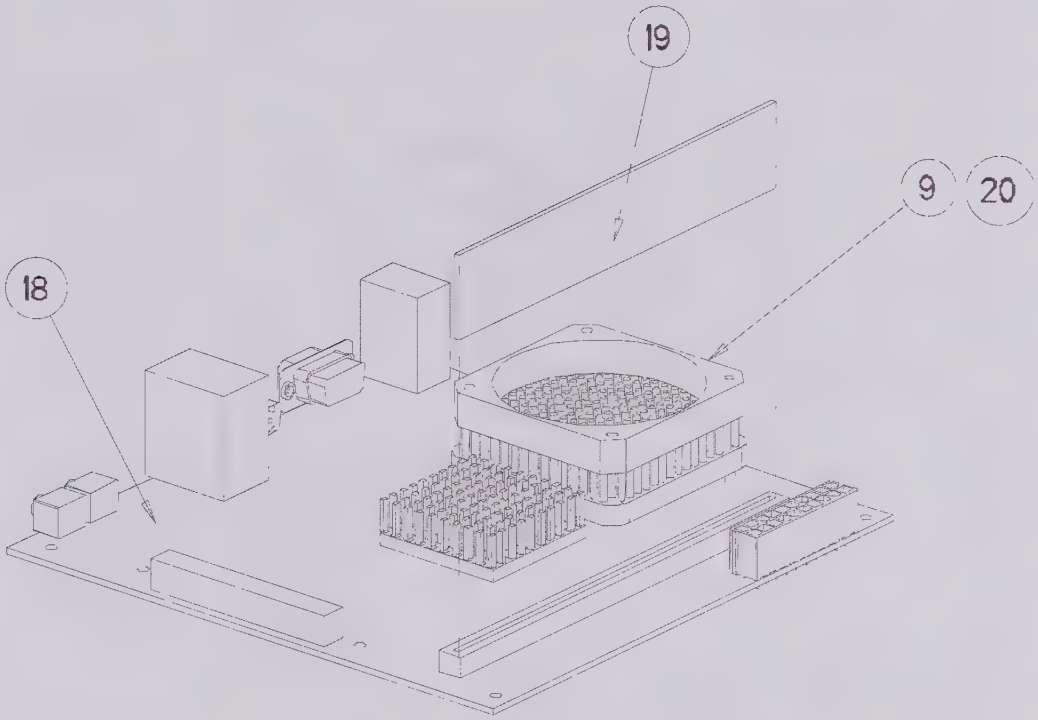



**Figure 8-14 Processor Assembly**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 9 | 227200013 | 1 | Celeron M processor 1.3 GHz |
| 18 | 913343-00 | 1 | PC Motherboard MX855-LC |
| 19 | 42334040001 | 1 | PC RAM 512MB DIMM |
| 20 | 913515-00 | 1 | CPU Cooler |

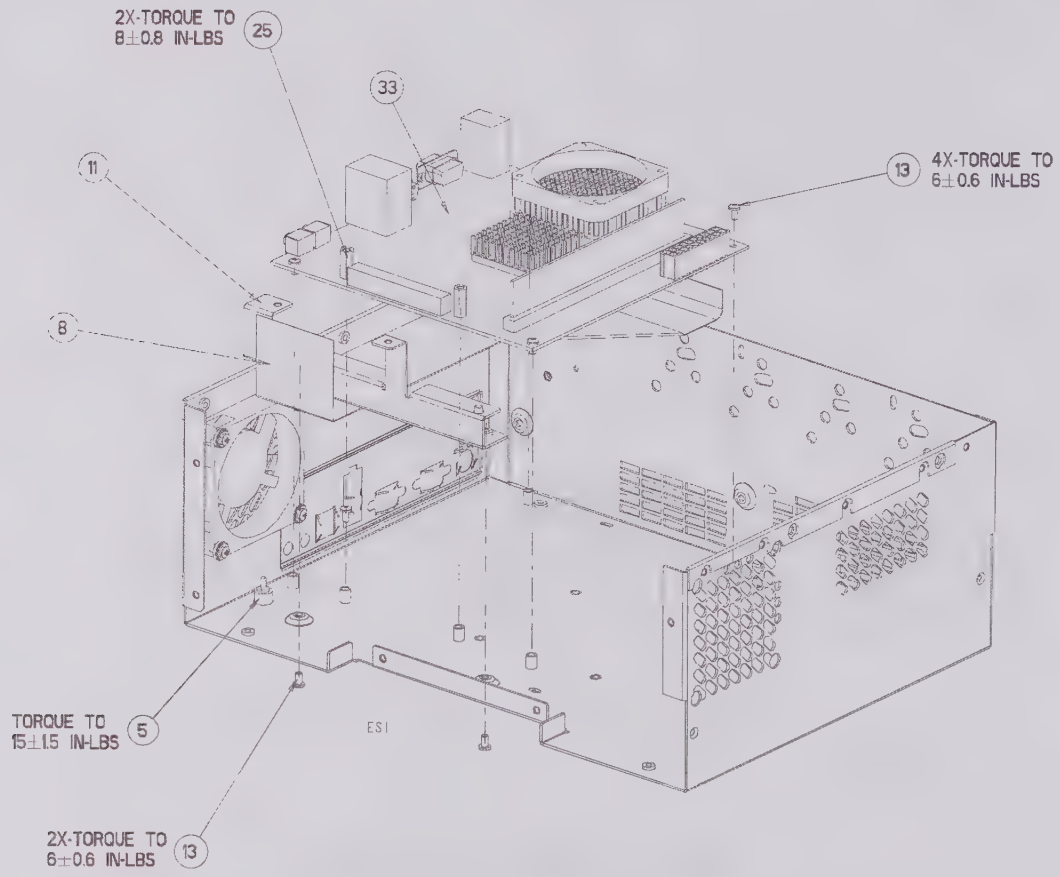



**Figure 8-15 Installation of Processor to Chassis**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 5 | 913324-00 | 1 | Trigger / Ready and Trig In BNC |
| 8 | 913373-00 | 1 | Hard Drive Cable Assembly |
| 11 | 913335-00 | 1 | PCI Support Bracket |
| 13 | 563430006 | 6 | Screw TX PAN M3X0.4-6MM S1 |
| 25 | 42524105004 | 2 | Standoff M/F Hex M3x15 |
| 33 | See Figure 8-14 | 1 | Configured CPU Motherboard Assy |

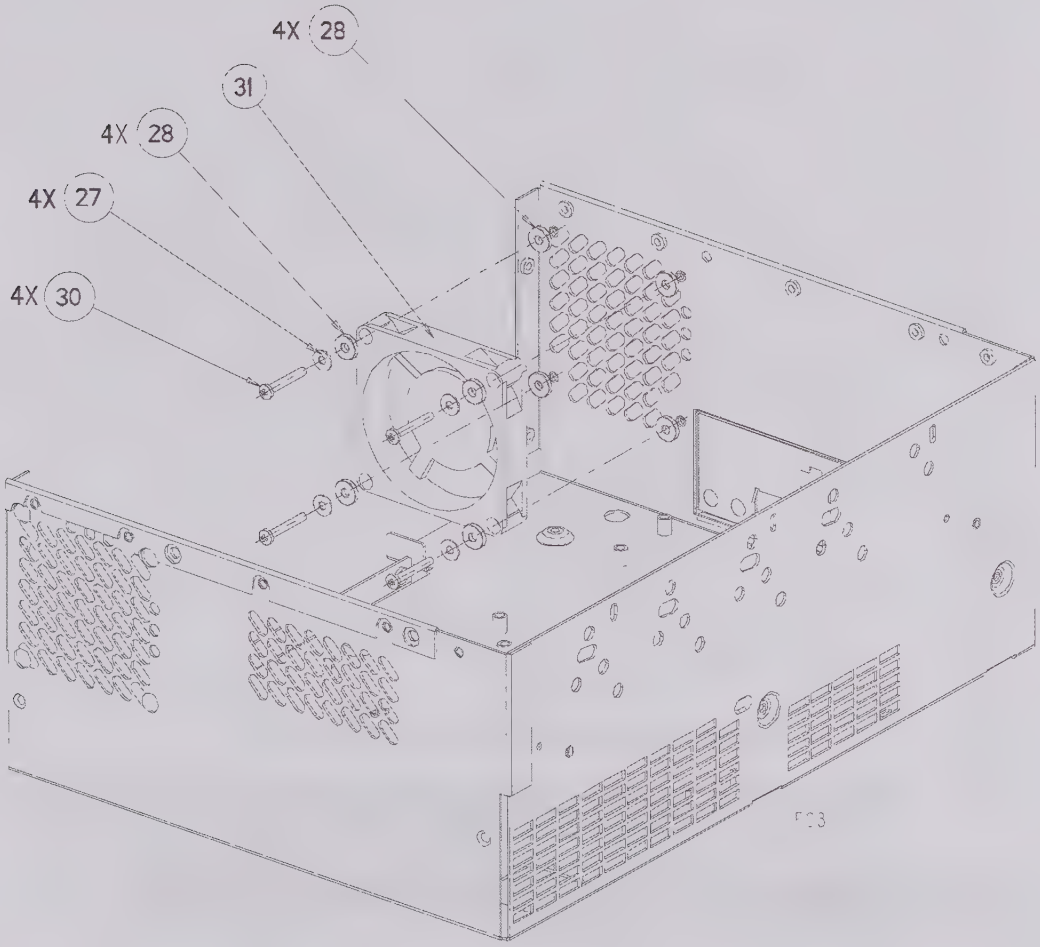



**Figure 8-16 Installation of Fan to Chassis**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 27 | 42551130100 | 4 | Washer Flat M3 9mm OD |
| 28 | 42575000001 | 8 | Washer Silicone 2mm Thick |
| 30 | 42550000004 | 4 | Screw pan HD Torx M3x22 w/patc |
| 31 | 913608-00 | 1 | 70 mm Fan Assembly |

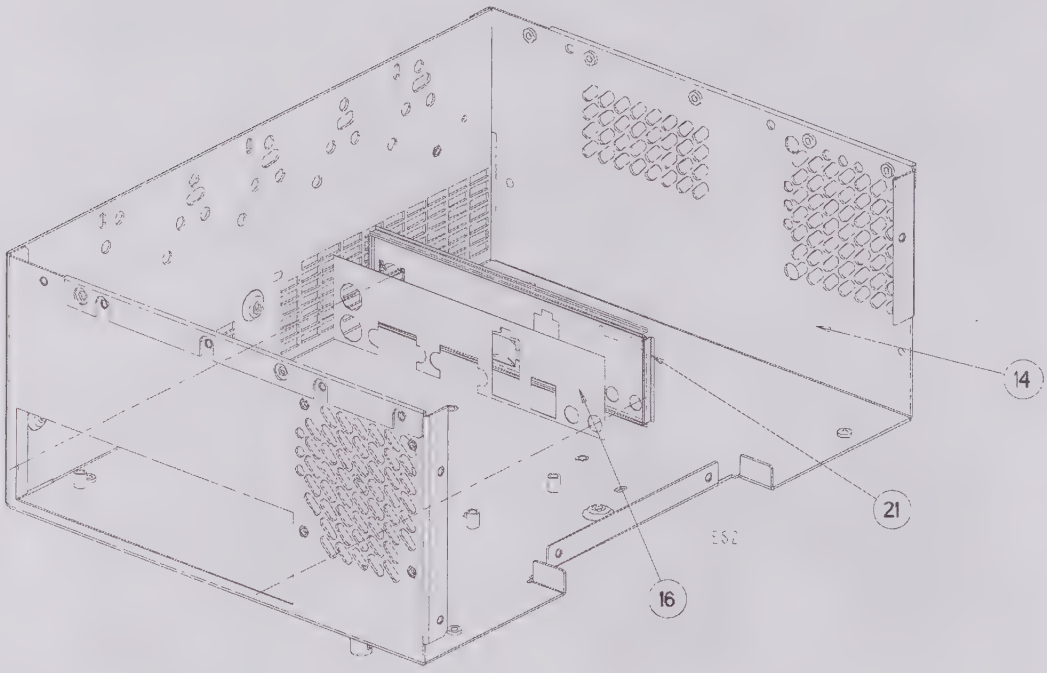



**Figure 8-17 Installation of IO shield to Chassis**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 14 | 913330-00 | 1 | Chassis Assy |
| 16 | 913514-00 | 1 | MB I/O Label |
| 21 | 913333-00 | 1 | I/O Plate |

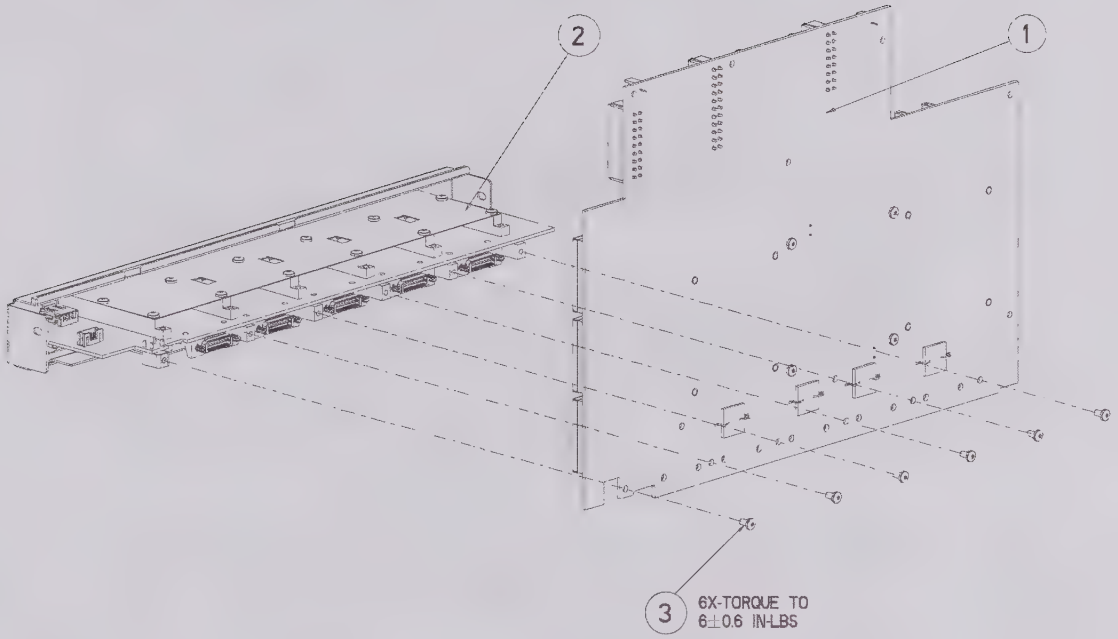



**Figure 8-18 Acquisition System Assembly**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 1 | 913461-00 | 1 | 600 MHz/4ch Acquisition Board |
| 2 | 913462-00 | 1 | 600 MHz/4ch Front End Board |
| 3 | 563430006 | 6 | Screw TX PAN M3X0.4-6MM S1 |

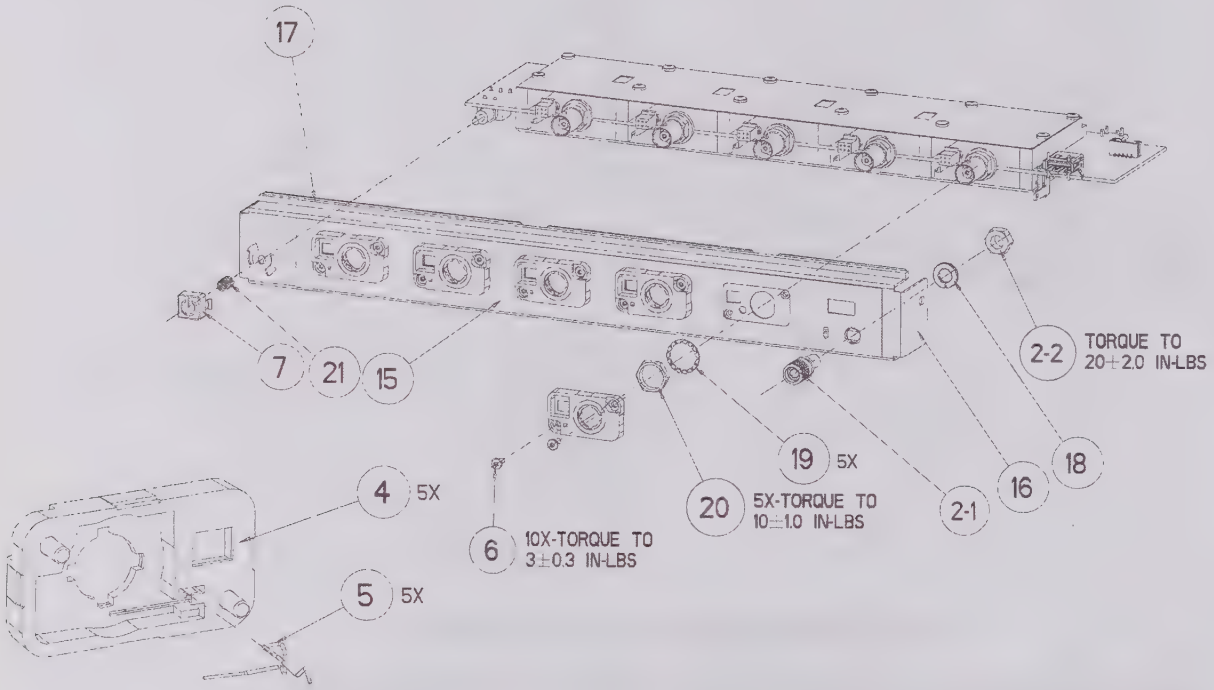



**Figure 8-19 Front End Main Card Panel Assembly**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 2 | 469040002 | 1 | Metal Banana Jack/Binding Post |
| 4 | 7093XXP41 | 5 | Probe Holder |
| 5 | 7093XXP91 | 5 | Probe Ring Contact |
| 6 | 554425003 | 10 | Screw S/Tap Phil M2.5X6 Black |
| 7 | 913354-00 | 1 | Power Button |
| 15 | 913578-00 | 1 | Main Card Panel Overlay |
| 16 | 913327-00 | 1 | Hornet Main Card Panel |
| 17 | 42350480001 | 1 | Gasket EMI Fabric 3x3mmx12.6in |
| 18 | 555465002 | 1 | Washer Lock Split 1/4 |
| 19 | 709614301 | 5 | BNC Lock Washer |
| 20 | 709614302 | 5 | BNC Nut |
| 21 | 42544220001 | 1 | Spring Compression .31 in L |

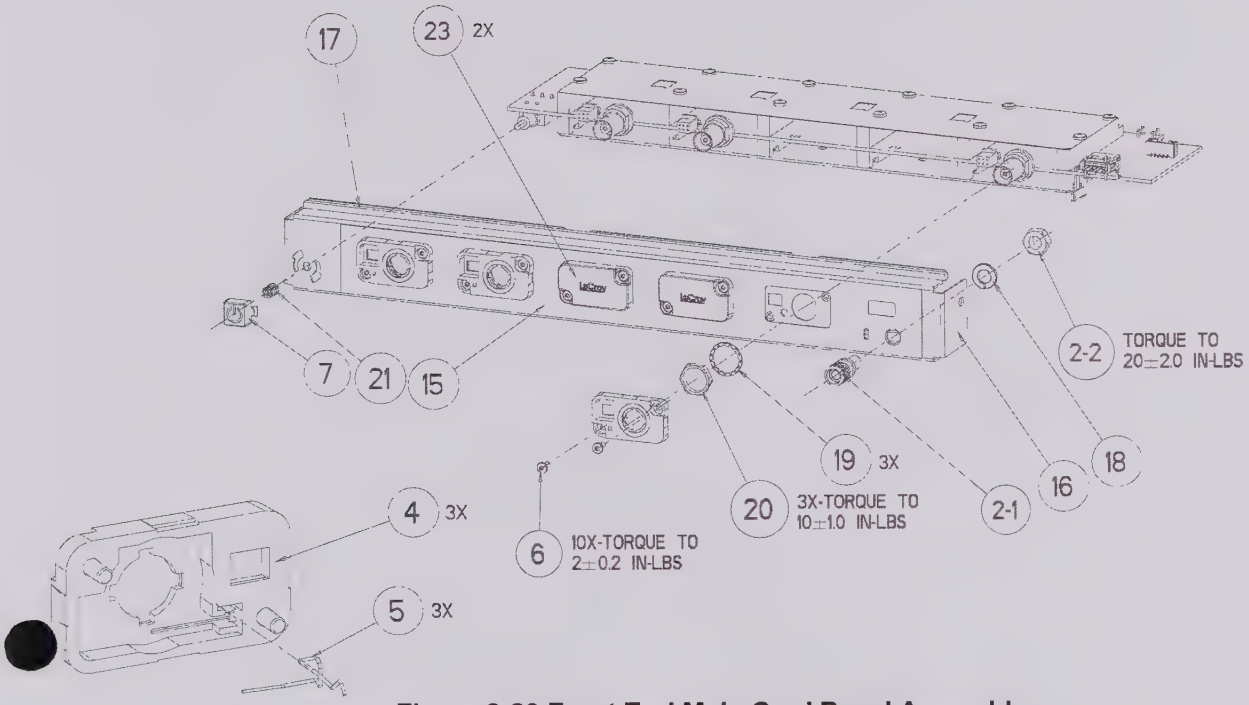



**Figure 8-20 Front End Main Card Panel Assembly**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 2 | 469040002 | 1 | Metal Banana Jack/Binding Post |
| 4 | 7093XXP41 | 5 | Probe Holder |
| 5 | 7093XXP91 | 5 | Probe Ring Contact |
| 6 | 554425003 | 10 | Screw S/Tap Phil M2.5X6 Black |
| 7 | 913354-00 | 1 | Power Button |
| 15 | 913578-00 | 1 | Main Card Panel Overlay |
| 16 | 913327-00 | 1 | Hornet Main Card Panel |
| 17 | 42350480001 | 1 | Gasket EMI Fabric 3x3mmx12.6in |
| 18 | 555465002 | 1 | Washer Lock Split 1/4 |
| 19 | 709614301 | 5 | BNC Lock Washer |
| 20 | 709614302 | 5 | BNC Nut |
| 21 | 42544220001 | 1 | Spring Compression .31 in L |

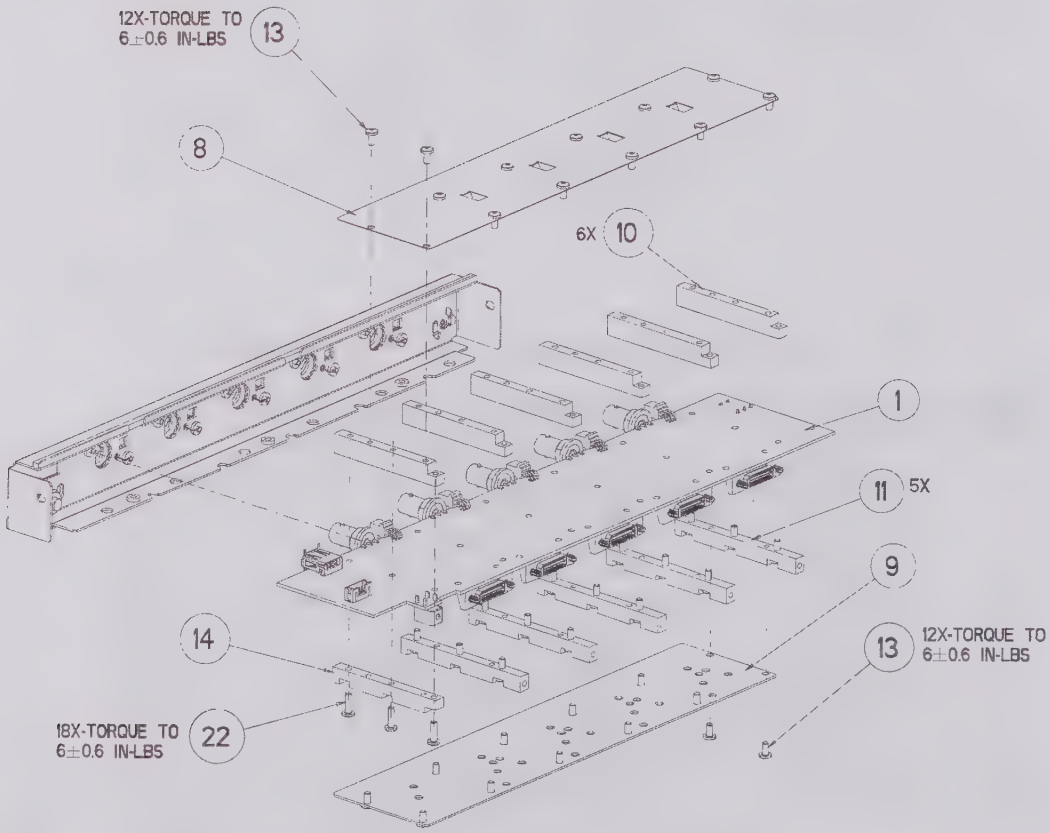



**Figure 8-21 Installation of Ribs & Shields to Front End Assembly**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 1 | 913597-00 | 1 | Front End PCA |
| 8 | 913374-00 | 1 | Front End EMI Shield Top |
| 9 | 913378-00 | 1 | Front End EMI Shield Bottom |
| 10 | 913379-00 | 6 | Front End EMI Rib Top |
| 11 | 913380-00 | 5 | Front End EMI Rib Bottom |

| | | | |
|---|---|---|---|
| 13 | 563430006 | 24 | SCREW TX PAN M3X0.4-6MM S1 |
| 14 | 913570-00 | 1 | EMI Rib Bottom Ext |
| 22 | 42550000003 | 18 | Screw Pan HD Torx m3x10 w/pa |

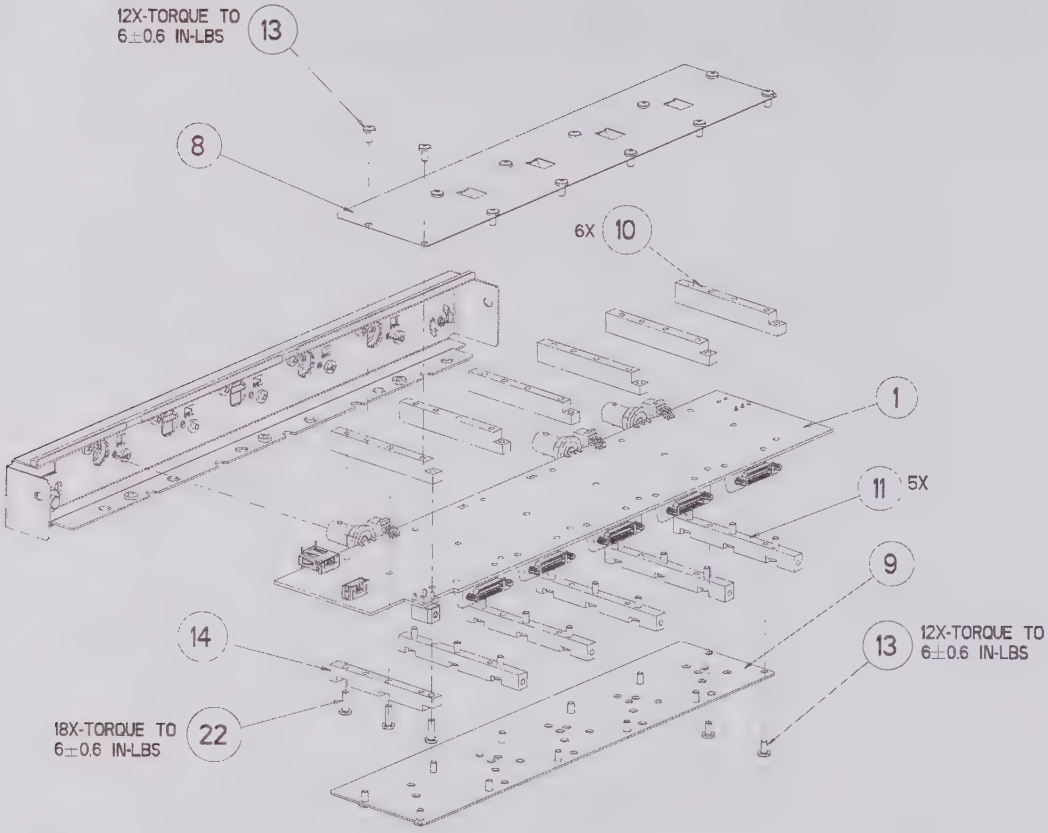



**Figure 8-22 Installation of Ribs & Shields to Front End Assembly**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 1 | 913597-00 | 1 | Front End PCA |
| 8 | 913374-00 | 1 | Front End EMI Shield Top |
| 9 | 913378-00 | 1 | Front End EMI Shield Bottom |
| 10 | 913379-00 | 6 | Front End EMI Rib Top |
| 11 | 913380-00 | 5 | Front End EMI Rib Bottom |
| 13 | 563430006 | 24 | SCREW TX PAN M3X0.4-6MM S1 |
| 14 | 913570-00 | 1 | EMI Rib Bottom Ext |
| 22 | 42550000003 | 18 | Screw Pan HD Torx m3x10 w/pa |

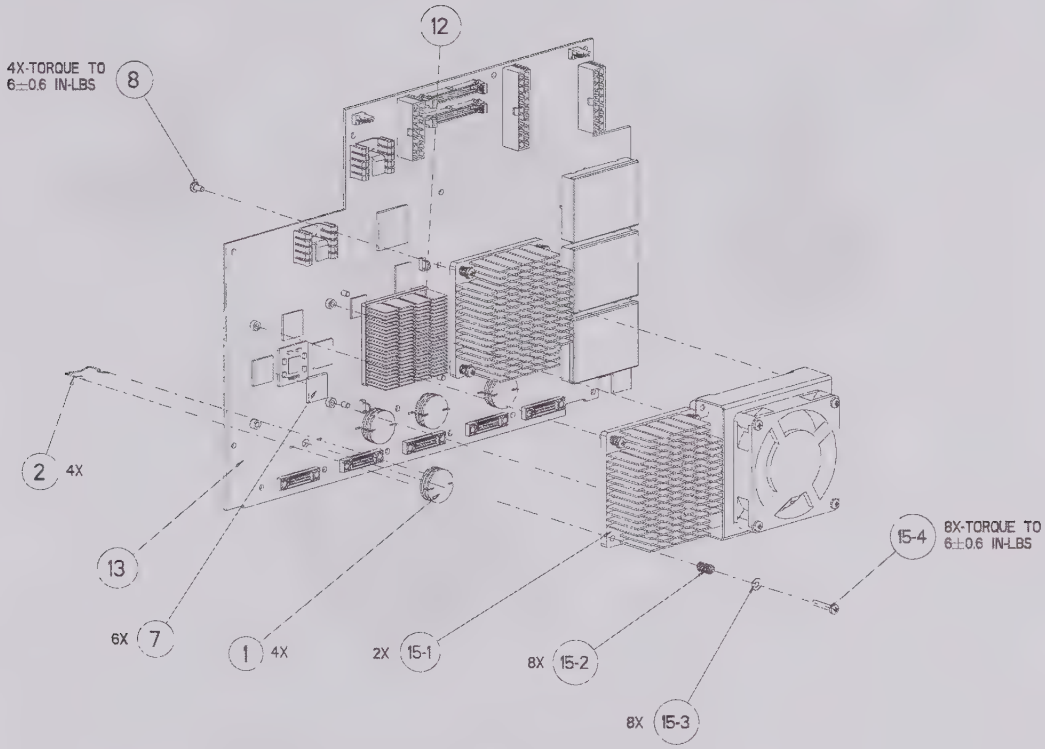



**Figure 8-23 Installation of ADC Heatsinks**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 1 | 709614330 | 4 | HFE428 Heatsink |
| 2 | 709614331 | 4 | HFE428 Heatsink Clip |
| 7 | 902528-00 | 6 | Thermal Gap Pad Die-Cut |
| 8 | 563430006 | 4 | Screw TX PAN M3X0.4-6MM S1 |
| 12 | 42507000001 | 1 | Heatsink S02GZZ0J 50mm SQ. |
| 13 | 913582-00 | 1 | Acquisition Board PCA |
| 14 | CH599041022 | 1 | Heat Sink Compound 251 |
| 15 | 42507000002 | 2 | Heatsink Assembly 70x70x40mm |

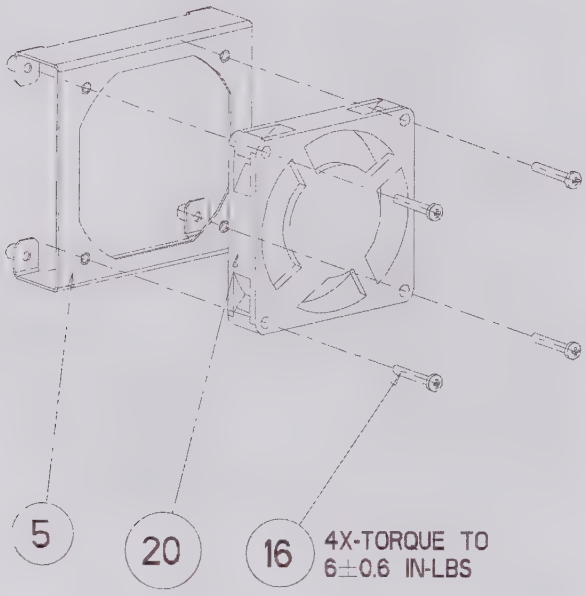



**Figure 8-24 MTT fan Assembly**

| Item | Part Number | Qty | Description |
|---|---|---|---|
| 5 | 913346-00 | 1 | Fan Tray |
| 16 | 550010120 | 4 | Screw Pan Head Phil M3X20 W/NY |
| 20 | 913608-00 | 1 | 70 mm Fan Assembly |

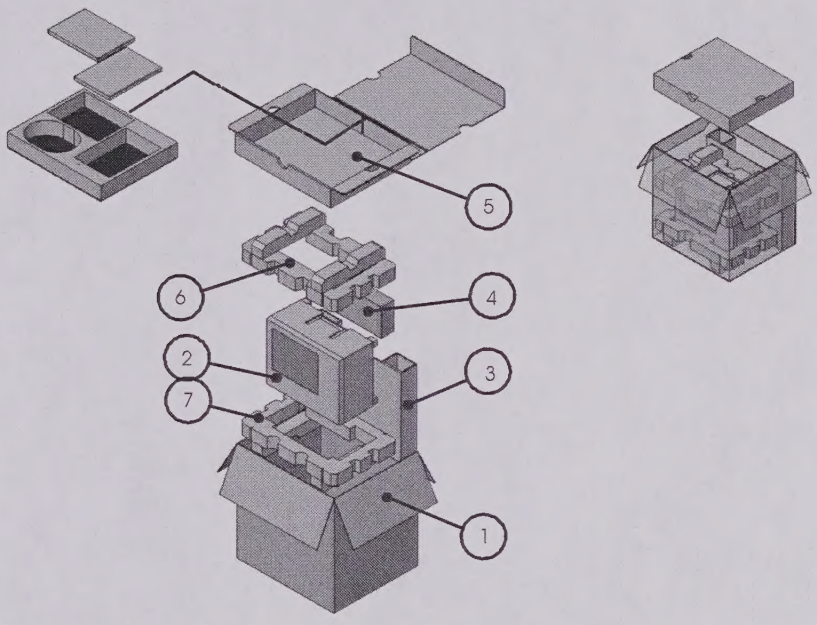



**Figure 8-25 Oscilloscope Packaging**

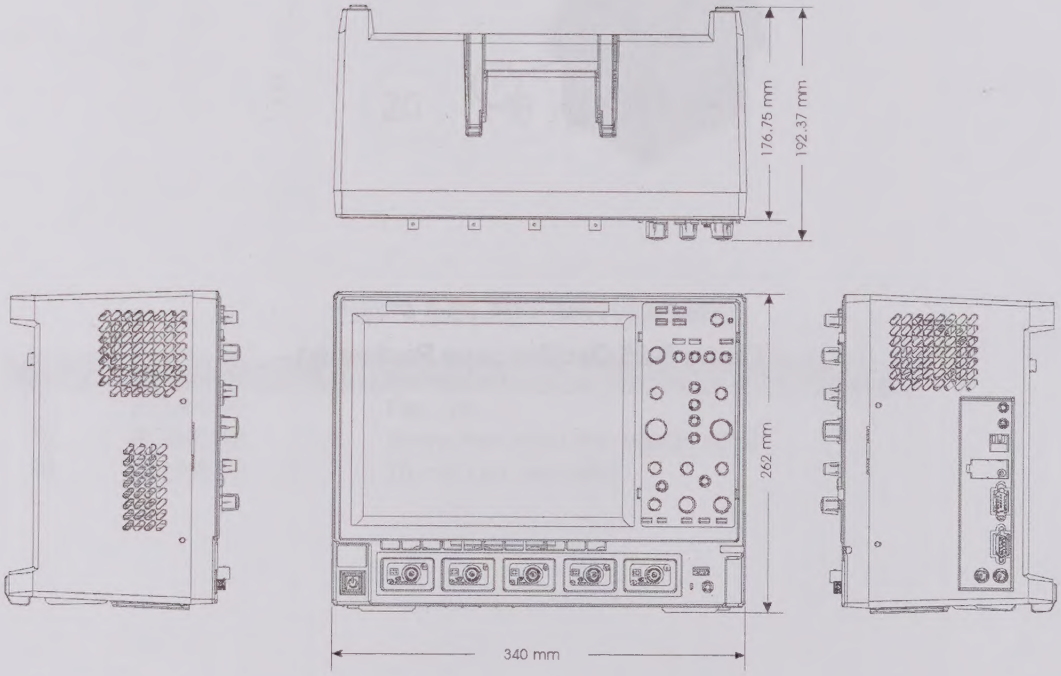



**Figure 8-26 Oscilloscope Dimensions**

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